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EFFECTS OF USING NATEC SERVICES WITHIN E-2C AND FA-18 OPERATIONAL SQUADRONS

by

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March 2007

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The thesis identifies Navy E-2C and FA-18 squadron metrics that are affected by Technical Representative (Tech Rep) Usage from Naval Air Technical and Engineering Service Command (NATEC). Six different databases are identified that contain the following types of metrics: Readiness, Standards and Policy (RS&P), Maintenance and Supply Chain Management (M&SCM); Fleet Readiness Training Plan (FRTP); Financial; Manpower; and Tech Rep Usage.

From the databases, twenty-four months of data is collected for 11 E-2C Squadrons and 37 FA-18 Squadrons. Exploratory Data Analysis is conducted to visually identify trends within the metrics as well as relationships amongst Tech Rep usage and the other metrics. At the completion of the Exploratory Analysis an overdispersed Poisson Regression Model is then developed, with a subset of metrics, to predict the number of Tech Rep assists per month. Relationships between the predicted Tech Rep Usage and the predictors in the model are then explored.

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EFFECTS OF USING NATEC SERVICES WITHIN E-2C AND FA-18 OPERATIONAL SQUADRONS

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LIST OF ABBREVIATIONS AND ACRONYMS

ACFT	Aircraft
AFAST	Aviation Financial Analysis Tool
AIMD	Aircraft Intermediate Maintenance Department
CANNS	Cannibalizations
CETS	Contractor Engineering Technical Services
CNAF	Commander Naval Air Forces
CNAL	Commander naval Air Forces, Atlantic
CNAP	Commander Naval Air Forces, Pacific
CNATT	Center for Naval Aviation Technical Training
COB	Current On Board
CVW	Carrier Air Wing
dCT	Depot Cycle Time
EDVR	Enlisted Distribution and Verification Report
EIS	Equipment in Service
ELAR	ETS Local Assist Request
eRIIP	Electronic Readiness Integrated Improvement Program
ETS	Engineering and Technical Services
FRC	Fleet Readiness Center
FRP	Fleet Response Plan
FRTP	Fleet Readiness Training Plan
MAF	Maintenance Action Form
M&SCM	Maintenance and Supply Chain Management
NATEC	Naval Air Technical and Engineering Service Command
NAVRIIP	Naval Aviation Readiness Integrated Improvement Program
NETS	Naval Engineering Technical Services
NMC	Non Mission Capable
NMCS	Non Mission Capable Supply
PMCS	Partly Mission Capable Supply
POM1	Pre-Overseas Movement
POM2	Post-Overseas Movement
RS&P	Readiness, Standards, and Policy
Tech Reps	Technical Representatives
TM	Type Model
TMS	Type Model Series
TYCOM	Type Commander

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EXECUTIVE SUMMARY

Naval Air Technical Data and Engineering Service Command (NATEC) provides state of the art Technical Data products and Engineering Technical Services (ETS) in support of Naval Aviation aircraft, weapons systems and support equipment. A major portion of ETS is provided by Technical Representatives (Tech Reps) who work for NATEC and are each experts in different areas of aviation maintenance for a particular type of aircraft. For NATEC to meet the needs of its customers, NATEC must understand the current patterns of Tech Rep usage under a variety of conditions. Ideally, this understanding will aid NATEC in constructing tools for tracking customer needs as those customer needs change (e.g. as new aviation technology is introduced, maintainer manning and training levels change, deployment cycles change, etc.). Ultimately, as NATEC becomes more able to track changes in patterns of Tech Rep usage, it should be able to better anticipate their customer's Tec Rep requirements.

The purpose of this thesis is to identify and explore databases and metrics that can be used to quantify some of the more important squadron characteristics that might or should drive Tech Rep usage. In addition, metrics that might be affected by Tech Rep usage are also identified. Finding and studying these metrics is part of NATECs Strategic Plan goal number four which is to "Collect and analyze data to develop predictive models that validate Technical Service requirements based on fleet-driven metrics." Only E-2 and FA-18 squadrons are studied in this thesis. E-2 and FA-18 squadrons are located on both the East and West Coasts. This allows us to further study differences between similar squadrons at different locations. Although these squadrons deploy together, the types of aircraft are completely different and have different maintenance issues that result in different trends or relationships among the metrics. After the metrics are compiled, an analysis is conducted to identify trends and relationships among them and with Tech Rep usage.

Research begins with identifying databases that contained squadron performance metrics and that are easily obtained. Six databases, or data sources, are identified that are easily accessible or easy to obtain. Aviation Financial Analysis Tool (AFAST) contains detailed financial data for each squadron along with parts usage and MAF entries. The month and phase of the Fleet Readiness and Training Plan (FRTP) in a squadron is a very important metric that is obtained and used extensively within this research. Engineering and Technical Services (ETS) Local Assist Request (ELAR) database is used to collect data on Tech Rep usage by the number and hours of assists per month per squadron. Readiness, Standards, and Policy (RS&P) metrics along with Maintenance & Supply Chain Management (M&SCM) metrics are obtained through the Electronic Readiness Integrated Improvement Program (eRIIP) database that is available online. To validate some of the data within eRIIP and also to complete missing data, Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) data is utilized, which is available in MS EXCEL. Lastly, maintainer manpower data is obtained from the Enlisted Distribution and Verification Report (EDVR) database from Millington, TN.

Exploratory analysis is then conducted to identify relationships between different variables within E-2C and FA-18 squadrons. Emphasis is given to analyzing the FRTP months and Tech Rep usage compared to other variables to identify trends between squadrons and coast. Numerous plots of the different metrics are constructed to obtain an understanding of the distribution of where a squadron is in its FRTP cycle; number of maintainers within a squadron throughout the FRTP cycle; percentage of DNEC that a squadron has during the FRTP cycle; Tech Rep usage throughout the FRTP cycle; and the relationships between Tech Rep usage and the other squadron performance metrics. Plots are constructed by FRTP month, FRTP phase, squadron, and coast in an attempt to identify different relationships and trends within the data. Looking at these plots clearly indicated that the coast and FRTP Phase that a squadron is in has an affect on Tech Rep usage.

By plotting each metric against the FRTP months by Coast, trends are identified for some metrics throughout the FRTP cycle. There are also some metrics that share similar trends. Within other plots of Tech Rep usage compared to other metrics, a few relationships are identified within a metric for a particular Coast and FRTP Phase. Where relationships do exist, there are not enough observations, with only two years of data, to say that the relationship is important. More relationships might also be identified with more data.

Tech Rep usage, as measured by number of assists per squadron per month, is modeled as a function of several of the metrics from Chapter II using an overdispersed quasi-Poisson regression model. Cross-validation is then conducted to get an estimate of the mean squared error of predicting Tech Rep usage. Relationships between the predicted Tech Rep usage and the predictors in the model are then explored. Because NATEC's ability to appropriately capture Tech Rep usage is still evolving, as are the other Navy databases, the results of this modeling effort serves to identify only general trends and provides an example of the type of analysis that might be used as historical data becomes available.

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I. INTRODUCTION

An approximate answer to the right question is worth a great deal more than a precise answer to the wrong question.
--The first golden rule of mathematics, sometimes attributed to John Tukey

Naval Air Technical Data and Engineering Service Command (NATEC) is the authoritative source for Naval Aviation technical data including technical manuals, technical directives, engineering drawings, and associated data. It provides state of the art Technical Data products and Engineering Technical Services (ETS) in support of Naval Aviation aircraft, weapons systems and support equipment. A major portion of ETS is provided by Technical Representatives (Tech Reps) who work for NATEC and are each experts in different areas of aviation maintenance for a particular type of aircraft. How much and how NATEC customers, in particular squadron's maintenance departments as well as in Aircraft Intermediate Maintenance Departments (AIMDs), use Tech Reps depends on many complex and interrelated factors. For example, when a squadron is not deployed, Tech Reps visit squadron spaces regularly and are readily available. However, when deployed or on exercises, maintainers rely upon technology (phone, email, and internet) to take advantage of Tech Rep Services. Only rarely, and only if the need is well justified, are Tech Reps sent to deployed customers. For NATEC to meet the needs of its customers, NATEC must understand the current patterns of Tech Rep usage under a variety of conditions. Ideally, this understanding will aid NATEC in constructing tools for tracking customer needs as those customer needs change (e.g. as new aviation technology is introduced, maintainer manning and training levels change, deployment cycles change, etc.). Ultimately, as NATEC becomes more able to track changes in patterns of Tech Rep usage, it should be able to better anticipate their customer's Tec Rep requirements.

The purpose of this thesis is to identify and explore metrics that can be used to quantify some of the more important squadron characteristics that might or should drive Tech Rep usage. In addition, metrics that might be affected by Tech Rep usage are also identified. Finding and studying these metrics is part of NATECs Strategic Plan [Naval Air Technical Data and Engineering Service Command (2005)] goal number four which is to “Collect and analyze data to develop predictive models that validate Technical Service requirements based on fleet-driven metrics.” Only E-2 and FA-18 squadrons are studied in this thesis. These squadrons have been previously studied [Chesterton (2005) and Buttrey, Koyak, Whitaker, & Read (2006)]. Both E-2 and FA-18 squadrons are located on the East and West Coasts. This allows us to further study differences between similar squadrons at different locations. Although these squadrons deploy together, the types of aircraft are completely different and have different maintenance issues that result in different trends or relationships among the metrics. After the metrics are compiled, an analysis is conducted to identify trends and relationships among them and with Tech Rep usage.

Figure 1. E-2Cs and FA-18s onboard the USS JOHN F. KENNEDY (CV-67)

A. BACKGROUND

1. Naval Air Technical and Engineering Service Command

Throughout the course of maintaining an aircraft, maintenance personnel ("maintainers") diagnose discrepancies by referencing their own training and experience, technical publications with prescribed troubleshooting techniques, and other personnel who may have performed similar maintenance in the past. If necessary, maintainers may request the expertise offered by government civil service or civilian contracted personnel who provide engineering and technical services. In addition to providing on-site troubleshooting expertise, these service providers, referred to as "Tech Reps" for short, supplement the training of maintenance personnel by providing more formal instruction in classroom settings and in squadron work centers [Chesterton (2005)].

In the Department of the Navy, Tech Reps are managed by NATEC. The origin of what is now NATEC, formerly known as Naval Aviation Engineering Service Unit (NAESU), was the response, in WWII, to the shortage of trained electronics technicians. On 1 October 1998, NAESU combined with Naval Air Technical Services Facility (NATSF) to form a new single command, Naval Air Technical Data and Engineering Services Command (NATEC) as it is now called. NATEC is now responsible for all areas of engineering and technical data. Within NATEC, Tech Reps are primarily responsible for training, including On the Job Training (OJT); formal classroom training; and mentoring. They serve as subject matter experts and also provide technical assistance with trouble-shooting.

There are two types of Tech Reps who work for NATEC: Naval Engineering Technical Services (NETS) and Contractor Engineering Technical Services (CETS). NETS are Department of Defense (DoD) employees and are managed by NATEC. CETS are engineering personnel contracted from industry to provide specific training/services on specific aircraft or systems for Department of the Navy personnel. "They assist operating activities to make better use of complex and expensive equipment furnished to them. Their experience and

talents are directed to serve the best interests of the Navy. They are assigned to a specific location, but can be sent temporarily (within the guidelines of their contract) to fill fleet requirements anywhere in the world [Trojan, D. (2006)]."

2. Metrics

To be able to successfully track Tech Rep usage and related squadron metrics, reliable databases must be identified. A major goal of this thesis is to identify such data sources. These databases must be easily accessible by NATEC and currently used by squadrons and higher commands (e.g. Commander Naval Air Forces (CNAF), Commander Naval Air Forces, Pacific (CNAP), Commander Naval Air Forces, Atlantic (CNAL), TYPE WINGs, Carrier Air Wings, etc.). They must be maintained and updated regularly as well as be as accurate as possible. Databases used by squadrons and higher commands have greater visibility and more regular use and hence, tend to be screened better for completeness and accuracy. In addition, more resources tend to be allocated to maintaining such databases. It is also important that NATEC use, whenever possible, the same metrics as are used by the rest of the fleet. Finally, because Tech Rep services are linked so closely to the 27-month deployment cycle, these databases need to have historical records dating back at least several years.

NATEC launched ETS Local Assist Request (ELAR), which is an in-house database, in August 2003 in an effort to collect data to track Tech Rep usage for both internal and external use. Within this database is a separate record for each assist which includes information such as: date the request was made; maintenance problem; Tech Rep assigned; date assist is completed; hour used for the assist; squadron assisted; and location. The quality of the data varies from squadron to squadron and by the individual entering the data. Although compliance with ELAR has increased since 2003, there are some Tech Reps who use ELAR to document almost all of their activities while others use ELAR minimally [Buttrey *et al.* (2007)]. In addition, important Tech Rep activities such as quick assists and morning rounds of customer space are not adequately captured by ELAR. Further, the way ELAR is used has evolved since August

2003. For example, NATEC recently (May 2006) made an administrative change whereby Tech Reps are now able to input their own ELAR data for a tech assist if the squadron fails to.

3. Current Changes

a. Customer Relationship Response and Resource Management (CRM)

ELAR is cumbersome to use and does not capture important aspects of Tech Rep usage. To replace ELAR, and expand NATEC's ability to meet customer needs, NATEC has contracted IBM to develop and employ CRM capabilities within its command [IBM Global Business Services (2006b)]. A concept of operations for this project has been developed [IBM Global Business Services (2006a)] and NATEC is currently working with IBM to develop the database that will be used with plans to pilot the new system in the summer of 2007. The insights gained in this thesis should help NATEC with this effort either directly or indirectly.

b. Fleet Readiness Centers (FRCs)

Although this thesis focuses on organizational level metrics, 30 percent of NATEC's Tech Rep services involve intermediate level maintenance. FRCs are designed to transform non-deployable AIMDs and depot-level maintenance into one activity. It places civil-servant experts together with their military maintainer counterparts to optimize readiness. Money is saved by reducing the number of Beyond Capable Maintenance (BCMs) items moved from the Intermediate to the depot levels. With Depot expertise next to the Intermediate-level maintainers, there should be reduced rework, faster turnaround times, improved reliability, and reduced shipping and transportation costs.

The FRC transformation began in October 2006 and the realignment is expected to be completed by October 2008. Further information about this realignment as well as FRC locations can be found in the CNAF website [Commander, Naval Air Forces (2007)]. As more AIMD locations are shifted over to FRCs, the need for Tech Rep assists at AIMDs could be reduced

or Tech Reps might take on a different role, as there will already be civilian experts integrated with military maintainers. Squadron metrics could also be affected with this transformation and should be taken into account with future analysis.

B. FOCUS AND ORGANIZATION OF THE THESIS

The ultimate goals of work in this area is to anticipate the needs for Tech Rep services and to compute the marginal effects of Tech Rep usage on readiness, performance, financial, and on manpower metrics within Navy E-2C and FA-18 squadrons. To help achieve this goal, this thesis identifies databases which contain metrics that are useful for this purpose. In addition, we study the relationships between these metrics and Tech Rep usage.

Chapter II describes the databases and the metrics used in this thesis. Chapter III contains exploratory analysis to identify trends, relationships, and other characteristics among the metrics obtained. Effects on Tech Rep usage based upon which coast a squadron is assigned to and where a squadrons is in its deployment cycle is also analyzed. Chapter IV begins with identifying subsets of variables which have a high degree of multicollinearity and subsets which are more linearly independent. It then builds upon the knowledge obtained in the previous chapter to develop a regression model to identify characteristics within the metrics that may predict Tech Rep usage. Chapter V then summarizes the work leading up to and including the analysis and then makes recommendations for changes that could assist with further analysis as well as recommendations for further study.

II. DATA COLLECTION

A. OBJECTIVE

The data collection effort focuses on data elements that quantify squadron characteristics by month and which are readily available from easily accessible databases. The goal in this section is to locate metrics within databases for FY-05 and FY-06 that are complete and as accurate as possible. When necessary, incomplete or obviously incorrect values are replaced using secondary sources of data. Focus is given to finding metrics that can be affected by Tech Rep Services as well as using metrics that are reviewed by upper management such as CNAF, CNAP, and CNAL. Metrics that can explain differences within the Fleet Readiness Training Plan are also sought. It is important that these databases be the same databases that the Navy is currently using to monitor readiness, funding, supply chain management and manpower. These large and frequently accessed databases are better maintained and tend to be more accurate than less frequently used databases.

B. METHODOLOGY

Six data sources are used in this thesis: Aviation Financial Analysis Tool (AFAST) for financial data; CNAF for the Fleet Readiness Training Plan (FRTP) of each squadron; ELAR database for Tech Rep usage; Electronic Readiness Integrated Improvement Program (eRIIP) for Readiness, Standards and Policy (RS&P) metrics and Maintenance and Supply Chain Management (M&SCM) metrics; Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) which also included RS&P and M&SCM metrics; and Enlisted Distribution and Verification Report (EDVR) for manpower data. From each of these sources, only metrics available from October 2004 through September 2006 (FY-05 and FY-06) are used. Each of the data sources provide data at differing levels of detail. Most of the data sources can give metrics aggregated on a monthly basis for each squadron. Metrics not available in this format are constructed when possible to give metrics by month by squadron. Only the following FA-18 and E-2 squadrons are included in this analysis:

FA-18 Squadrons		E-2C Squadrons
East Coast	**West Coast**	**East Coast**
VFA-11	VFA-2	VAW-120
VFA-15	VFA-14	VAW-121
VFA-34	VFA-22	VAW-123
VFA-37	VFA-25	VAW-124
VFA-81	VFA-34	VAW-125
VFA-82	VFA-41	VAW-126
VFA-83	VFA-94	
VFA-86	VFA-97	**West Coast**
VFA-87	VFA-113	VAW-112
VFA-103	VFA-115	VAW-113
VFA-105	VFA-122	VAW-116
VFA-106 C/D	VFA-125	VAW-117
VFA-106 E/F	VFA-137	
VFA-131	VFA-146	**Japan**
VFA-136	VFA-147	VAW-115
VFA-143	VFA-151	
VFA-211	VFA-154	
	Japan	
	VFA-102	
	VFA-27	
	VFA-192	
	VFA-195	

Table 1. List of FA-18 and E-2C Squadrons

C. METRICS AND THEIR SOURCES

1. Aviation Financial Analysis Tool (AFAST) Metrics

The AFAST database provides financial metrics for squadrons. It consists of four different databases: AFAST User; Cockpit Charts; Type Wing Tools; and Air Wing Tools which are explained in detail in this section. Information about how to use the database interface and further explanation of the databases, beyond what is explained below, is contained in “AFAST Introduction and Basic Users Guide” [Commander, Naval Air Forces (2003)]. The databases are MS ACCESS based and can be downloaded with the use of a Common Access Card (CAC) through the CNAF Extranet website at https://extra.cnaf.navy.mil/. Data within the databases can easily be reviewed and queries developed to

acquire the required metrics in the format needed for further analysis. An understanding of MS ACCESS is extremely beneficial for extracting the required data in the proper format.

a. Cockpit Charts

AFAST Cockpit Charts is a managerial tool to analyze and track funding at the macro level (CNAF and Type Commander (TYCOM)). The AFAST Cockpit Chart provides the user with an EXCEL spreadsheet containing numerous worksheets that have graphical representations of the metrics for the current Fiscal Year by category and by months. Examples are included in Figure 37 in Appendix A. This tool is useful for tracking executed funding versus planned funding along with flying hours and cost per flight-hour aggregated in various ways. The data can be aggregated according to Type Wing, or all Type Wings of a particular type; Carrier Wing; Squadron; Type Model (TM); or Type Model Series (TMS). This database only contains data for a single Fiscal Year. Databases for FY-05 and FY-06 are available on the website for download.

The following data is extracted from this database for further analysis: Squadron; UIC; Year and month; Flight Hours; Planned Fuel; Planned AVDLR; Planned AFM; Expended Fuel; Expended AVDLR; Expended AFM; Expended Squadron AFM; Expended AFM AIMD; Expended AFM Overhead, Type Model (TM), and Type Model Series (TMS).

Planned Funding is the funding that is planned to be expended for a particular category (Fuel, AVDLR, or AFM) during a certain month.

Fuel Funding is funding that is used to purchase aviation fuel for the aircraft.

Aviation Depot Level Repairable (AVDLR) Funding is used to purchase high-cost depot repairable parts.

Aviation Fleet Maintenance (AFM) Funding is used to purchase items such as consumable repair parts (gaskets, tires, wire, etc.), tools, greases, safety and flight deck shoes, etc.

Squadron AFM is AFM funding that is used at the squadron level.

AFM AIMD is AFM funding that is used by AIMD to repair a Depot Level Repairable part. This is calculated by adding up all of the AIMD AFM and subtracting out AFM Overhead.

AFM Overhead is AFM funding that is used by AIMD in support of common gear that is used for all of the squadrons. The cost is divided among squadrons on a fair-share basis by flight hours.

The tables within AFAST Cockpit Chart used to extract the data are SQDLST; cpSum1; CPI_CNAF; and CPC_PLAN. The SQDLST table contains the squadron number and UIC's. The fields within the cpSum1 table that are used are NAME (squadron number); CCYYMM (Year and Month); ACTFUEL_TO (Expended Fuel Funding); ACTAVD_TOT (Expended AVDLR Funding); ACTAFM_TOT (Expended AFM); H_TOT (Flight Hours Flown); AFMOTH_TOT (Expended Squadron AFM Funding); AIMDAFM_TO (AIMD AFM); and AFMOVHD_TO (Expended AFM Overhead Funding). The Expended AFM AIMD Funding is calculated by subtracting AFMOVHD_TO from AIMDAFM_TO. The fields within the CPC_PLAN table that are used are NAME (squadron number); SQDN (squadron UIC); YRMON (Year and Month); PFUEL (Planned Fuel Funding); PAVDLR (Planned AVDLR Funding); and PAFM (Planned AFM Funding). Within the SQDLST table, an extra field is added to put the sort order of the squadrons required for analysis which also made developing the queries easier. The SQDLST table is linked to the cpSum1 table by SQDLST.SQDN and cpSum1.SQDN within a query to extract the required data. The cpSum1 and CPI_CNAF tables are linked together by SQDN to extract the TM and TMS of aircraft in each squadron per month.

b. Type Wing Tools

The AFAST Type Wing Tools are managerial tools that provide detailed transaction data, cost drivers, and item research capability. Detailed Maintenance Action Form (MAF) data is also available within the database. This database is used to extract the number of Non Mission Capable Supply (NMCS) and Partly Mission Capable Supply (PMCS) requisitions (NMCS/PMCS); Percent of First Day Issue of NMCS/PMCS requisitions; and number of Non-NMCS/PMCS requisitions at the squadron level per month. This data is available within eRIIP but contains requisitions that are generated by AIMD as well as at the squadron level. A separate database is used for each Type Wing.

NMCS/PMCS are the number of priority 02 and 03 requisitions that are required at the squadron level to correct a discrepancy on the aircraft to bring it to a Fully Mission Capable (FMC) status.

Percent of First Day Issue is the percent of NMCS/PMCS requisitions that are issued on either the day of or the day after the requisition is submitted.

Non-NMCS/PMCS are the number of priority 04 and below requisitions that are used for routine maintenance.

The table within AFAST Type Wing Tools used to extract the data is TWING. The fields within the TWING table that are used are NAME (squadron number); ORDERDT (date the requisition is submitted); PRI (priority of the requisition); STATUS (status of the requisition, which did not include status of CANC); and ORDERDATE (Julian date for the day the requisition is submitted). The STATUS field contains the Julian date and the status (i.e. 065COMPL). It is compared to the ORDERDATE field to determine if a requisition was issued on the day of or the day after the requisition was submitted which is needed to calculate the Percent First Day Issue. Queries within the Type Wing Tools database are developed to extract the required data in the proper format.

c. *AFAST User*

AFAST User is a managerial tool to analyze and track funding at the macro level with metrics aggregated by funding type for the Type Commander (TYCOM), Carrier, Carrier Air Group, or Type WING. At the micro level, metrics are aggregated by funding type for a specific squadron and can be further aggregated for AVDLR and AFM by Engine, Avionics, Airframe, Overhead, Other, and Squadron AFM. Screenshots of the macro and micro level are available in Figure 35 and Figure 36, both in Appendix A. At the macro level, flight hours, and executed and targeted (planned) funding for Fuel, AVDLR, AFM, and Totals along with the cost per flight hour are available for each metric. These are also available at the micro level. The supporting data for all AFAST screenshots is easily downloaded to an EXCEL spreadsheet for further analysis. Metrics at the macro level are the same as what is available in AFAST Cockpit Charts.

Data at the micro level for each squadron where AVDLR and AFM funding is further aggregated was to be used for analysis. However, inspection of this financial data uncovered enough anomalies to render this data unusable. An example of this is demonstrated in Table 2 where the AVDLR airframe expenditures for VFA-105 are extracted from the AFAST User database. During April 2005, the expenditure for AVDLR airframe is $1,568 which is an order of magnitude lower than all of the other values. In addition, we could not find another database to validate or correct this value.

The tables within AFAST User used to extract the data are stat and sum_mon. The fields within the stat table that are used are the squadron number and UICs. The sum_mon table contains the following fields that are used: SQDN (Squadron UIC); ACCNT (either AVDLR, AFM, or FUEL); BRKDWN (subcategory); and YRMON (Year and Month). The two tables are linked together in a query by stat.UIC and sum_mon.SQDN to extract the required data.

NAME	Number	YRMON	ACCNT	BRKDWN	SumOfTOTAL
VFA-105	2	200410	AVDL	AIR	247,844
VFA-105	2	200411	AVDL	AIR	149,957
VFA-105	2	200412	AVDL	AIR	224,948
VFA-105	2	200501	AVDL	AIR	259,947
VFA-105	2	200502	AVDL	AIR	208,672
VFA-105	2	200503	AVDL	AIR	227,761
VFA-105	2	200504	AVDL	AIR	1,568
VFA-105	2	200505	AVDL	AIR	267,624
VFA-105	2	200506	AVDL	AIR	222,839
VFA-105	2	200507	AVDL	AIR	191,790
VFA-105	2	200508	AVDL	AIR	555,839
VFA-105	2	200509	AVDL	AIR	71,769
VFA-105	2	200510	AVDL	AIR	114,436
VFA-105	2	200511	AVDL	AIR	176,467
VFA-105	2	200512	AVDL	AIR	133,297
VFA-105	2	200601	AVDL	AIR	110,138
VFA-105	2	200602	AVDL	AIR	246,519
VFA-105	2	200607	AVDL	AIR	18,894
VFA-105	2	200608	AVDL	AIR	113,674
VFA-105	2	200609	AVDL	AIR	44,700

Table 2. AVDLR Airframe Expenditures for VFA-105 Extracted from AFAST User

d. Air Wing Tools

The AFAST Air Wing Tools are similar to the Type Wing Tools except that the contain data on all of the aircraft for a particular Carrier Air Wing.

2. Commander Naval Air Forces (CNAF) Metrics

Metrics available from CNAF are vital for understanding Tech Rep usage and all the other squadron metrics studied in this thesis. The metrics, Fleet Readiness Training Plan (FRTP) Month (commonly referred to as the R+ Month), and FRTP Phase that each squadron is in by month identifies where each squadron is in its FRTP cycle.

a. FRTP Month

The FRTP Month indicates where a squadron is within its FRTP, which is a 27-month cycle. A squadron can be in a particular R+ month more than one month or can skip R+ months depending on when its next deployment is scheduled and on the Fleet Response Plan (FRP). The R+ month a squadron is in determines what Type Model Series (TMS) Readiness Standards it is required to achieve. The TMS Readiness Standards for each TMS can be found

in COMNAVAIRFOR INSTRUCTION 3510 series [Commander, Naval Air Forces (2006)]. These metrics are contained in the electronic Readiness Integrated Improvement Program (eRIIP) database that is described in the next section.

b. FRTP Phases

Each R+ Month is classified in one of six different phases (Reconstitute, Basic, Intermediate, Surge 1, Deployed, or Surge 2).

The Reconstitute (or Maintenance) Phase consists of R+1 through R+4 for E-2 squadrons and R+1 through R+6 for FA-18 squadrons. During this phase, squadrons perform extensive maintenance on the aircraft to get them ready for the future phases of the FRTP.

The Basic Phase consists of R+5 through R+9 for E-2 squadrons and R+7 through R+9 for FA-18 squadrons. During this phase, unit-level training which will prepare the squadron for the next phase is completed.

The Intermediate (or Integrated) phase consists of R+10 through R+12 for E-2 and FA-18 squadrons. During this phase, the squadrons are integrated with the carrier that they will be deploying with, and complete the Composite Training Underway Exercise (COMPTUEX), which is an exercise with the carrier battle group. They also complete carrier air wing strike training at NAS Fallon prior to entering the next phase of the FRTP.

Surge 1 (or Sustainment) phase consists of R+13 through R+16 for E-2C and FA-18 squadrons. During this phase, squadrons continue with training to maintain their level of readiness until deployment. This phase usually consists of a Joint Task Force Exercise (JTFX) with the battlegroup. During this time, the squadron can also be called upon to deploy if the need arises.

The Deployment phase is usually six months in duration and includes FRTP months R+17 through R+22. At this time the squadrons are deployed with the battlegroup.

After a squadron returns from deployment it then enters the Surge 2 (or Sustainment) phase which consists of FRTP months R+23 through R+27. The squadrons are required to maintain a certain level of readiness in the event that they are required to deploy on short notice.

3. Electronic Readiness Integrated Improvement Program (eRIIP) Metrics

The eRIIP database is an extremely powerful management tool which contains data from the beginning of FY-03. Most of the metrics used for this thesis came from the eRIIP database. This database is used to capture the TMS Readiness Standards that each squadron has achieved each month. These metrics are classified as Readiness, Standards & Policy (RS&P) metrics and Maintenance and Supply Chain Management (M&SCM) metrics. The database is web-based and available with a CAC card along with a current NALDA account at http://www.cnaf.navy.mil/navriip/main.asp?ItemID=122. From the website, the path to get to the database is eRIIP CpCs & Cubes; Cubes; eRIIP Cubes; eRIIP.

We note that there are some missing data in most of the eRIIP metrics. The FA-18 data is more complete than E-2C data. Some of the metrics within eRIIP were also not captured until FY-06. To complete the missing data, Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) EXCEL spreadsheets, described in the next section, are used. We note that values for data contained in both eRIIP and NAVRIIP are not always the same. Some instances of this are included in Table 3. For Sortie Accomplishment, the difference between the two databases is too great for most squadrons to be able to use this metric in analysis. For the purpose of this thesis, data from eRIIP is used to the fullest extent possible.

We also note that, although manpower metrics are available in eRIIP for Billets Authorized, and Current on Board, they are not used because they contain some missing values. Instead, these manpower metrics are extracted from the EDVR database described in section 5 of this chapter.

Mo/Yr	Sortie Accomplishment eRIIP VAW-XXX	NAVRIIP VAW-XXX	Diff.	Cannibalizations eRIIP VAW-XXX	NAVRIIP VAW-XXX	Diff.	Flight Hours Actual eRIIP VFA-XXX	NAVRIIP VFA-XXX	Diff.
Oct-04	95	88	7	10	10	0	250	250	0
Nov-04	63	44	19	21	19	2	297	297	0
Dec-04	43	46	(3)	12	9	3	133	133	0
Jan-05	86	78	8	8	7	1	422	422	0
Feb-05	98	77	21	15	15	0	338	337	1
Mar-05	118	106	12	31	17	14	583	583	0
Apr-05	62	51	11	28	22	6	770	770	0
May-05	157	144	13	35	31	4	856	856	0
Jun-05	123	141	(18)	16	14	2	724	724	0
Jul-05	145	144	1	44	40	4	144	144	0
Aug-05	77	81	(4)	6	6	0	96	95	1
Sep-05	114	122	(8)	34	25	9	415	415	0
Oct-05	193	185	8	104	41	63	264	264	0
Nov-05	152	153	(1)	67	67	0	309	309	0
Dec-05	176	174	2	101	101	0	169	169	0
Jan-06	200	212	(12)	99	97	2	146	157	(11)
Feb-06	90	87	3	42	42	0	192	215	(23)
Mar-06	39	54	(15)	6	6	0	325	370	(45)
Apr-06	21	29	(8)	9	9	0	168	180	(12)
May-06	120	112	8	23	23	0	284	325	(41)
Jun-06	76	72	4	27	27	0	313	369	(56)
Jul-06	105	119	(14)	16	18	(2)	272	292	(20)
Aug-06	58	69	(11)	15	13	2	326	369	(43)
Sep-06	44	153	(109)	16	17	(1)	367	396	(29)

Table 3. Comparison of eRIIP and NAVRIIP Metrics

a. Readiness, Standards & Policy (RS&P) Metrics

RS&P metrics are used to track and analyze Ready for Tasking (RFT) requirements along with TMS Standards. These include:

Flight Hour Accomplishment – The actual number of flight hours flown in a given month for a particular squadron.

Flight Hour Entitlement – The number of flight hours authorized to be flown which is determined by the TMS Readiness Standards. Missing data for this metric is obtained from NAVRIIP as well as COMNAVAIRFORINST 3510 series [Commander, Naval Air Forces (2006)].

Sortie Entitlement – The number of training sorties authorized per the TMS Readiness Standards [Commander, Naval Air Forces (2006)] which a squadron uses to meet an expected M-rating.

b. Maintenance & Supply Chain Management (M&SCM) Metrics

M&SCM metrics are used to analyze metrics that effect the maintenance cycle and Supply Chain Management. These include:

Aircraft in Service (ACFT in Service) – The number of aircraft during the month that were in a Mission Capable status. This is calculated as

$$\frac{\text{Total EIS Hours}}{\text{Number of Hours in the Month}}.$$

Aircraft Inventory (ACFT Inventory) – the number of aircraft in a squadron for a particular month.

Cannibalizations (Canns) – The number of serviceable parts per month that are removed from one piece of equipment or aircraft are then installed in another to make repairs to and bring the aircraft back to a Mission Capable status.

Canns per 100 Flight Hours – The number of cannibalizations performed per each 100 flight hours per month. This is computes as

$$\frac{\text{Total number of cannibalizations}}{\text{Total number of flight hours/100}}.$$

Canns per 100 Flight Hours Entitlement – The entitlement for all CNAF aircraft is nine cannibalizations per 100 flight hours.

Days in Month – The number of days in a given month.

Depot Cycle Time (dCT) – The amount of time necessary to return a down ACFT (NMC status) to Mission Capable status. This is computed as $\frac{\text{(Non Depot WIP) * \# of days in month}}{\text{"O" level ACFT throughput}}$.

Direct Maintenance Man Hour (DMMH) – The number of Direct Maintenance Man Hours that were used to perform maintenance on aircraft within the squadron.

Direct Maintenance Man Hour per Flight Hour (DMMH per Flt Hr) – The total number of Direct Maintenance Man Hours expended for each reported Aircraft Flight Hour. This is computed as

$$\frac{\text{Total Direct Maintenance Man Hours}}{\text{Total ACFT Flight Hours}}.$$

Equipment in Service Hours (EIS Hours) – The number of hours per month during which the aircraft is not in a Non Mission Capable (NMC) status.

Flight Hours per Non Mission Capable (NMC) Event – The number of flight hours flown between each documented NMC event. This is computed as $\frac{\text{Total Flight Hours}}{\text{\# Z Code Events}}$.

Hours in Month – The number of hours in a given month.

Non-Depot In-Work Aircraft (Non Depot WIP) – The number of ACFT in an operational status Non Mission Capable (NMC) due to maintenance or supply at the "O" level.

Non Mission Capable (NMC) Events – The number of times per month that aircraft within a squadron went into NMC status.

Non Mission Capable Hours (NMC Hours) – The number of hours per month the aircraft are in NMC status.

Non Mission Capable Rate (NMC Rate) – The number of NMC Hours per EIS Hours. This is computed as $\frac{\text{Total NMC Hours}}{\text{Total EIS Hours}}$.

Ready for Tasking (RFT) - This is a measure of shortfalls to the number of aircraft, appropriately configured, that are available to fly readiness training or operational tasking sorties during any phase of the FRTP. "Understanding Ready for Tasking (RFT) Calculations" [Commander, Naval Air Forces Extranet (2006)] explains how the RFT calculation is derived.

Ready for Tasking (RFT) Entitlement – The number of appropriately configured aircraft designated by the TMS and FRTP Standards that a squadron is required to achieve.

Throughput – Measures the number of aircraft going into and out of NMC status. This is the sum of the number # of ACFT going into NMC status for the entire month and the number of ACFT coming out of NMC status for the entire month.

Trained Manpower per DNEC – Number of enlisted personnel (grades E1 through E8) assigned to the Maintenance Department, and holding a required NEC (ratings AD, AM, AME, AT, AE, or AO) a proportion of the total number of required DNEC billets authorized to the squadron per the Activity Manning Document. This is computed as

$$\frac{\text{Number of personnel filling an authorized DNEC Billet}}{\text{Total number of DNEC Billets Authorized}}.$$

4. Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) Metrics

This database is also used to capture the TMS Readiness Standards that each squadron has achieved each month. All of the metrics that are in NAVRIIP are also in the eRIIP database. The NAVRIIP database is EXCEL-based and spreadsheets are separated by TMS, Coast, RS&P, and M&SCM. Within each EXCEL spreadsheet, each squadron has two workbooks (one for deployed and one for non-deployed). The metrics are used to validate and/or complete missing information from eRIIP. The spreadsheets are easily obtained by sending an email to the POC at NAVAIR.

5. Enlisted Distribution and Verification Report (EDVR) Metrics

The Enlisted Distribution and Verification Report (EDVR) is distributed monthly by Enlisted Personnel Management Center (EPMAC) to all naval activities. The EDVR contains information such as prospective gains; prospective losses; number of personnel on board by rate and by rank; required Navy Enlisted Classifications (NEC); and number of personnel that are billeted into a billet that requires a certain NEC. For a more detailed explanation of what

is included in the EDVR, refer to the EDVR User's Manual [Enlisted Personnel Management Center (1999)].

Within eRIIP, the following maintainer ratings are combined for number of billets authorized (BA) and current on board (COB):

Aviation Machinist's Mate (AD) – ADs maintain, service, adjust, and replace aircraft engines and accessories.

Aviation Electronics Mate (AE) – AEs maintain, adjust, and repair aircraft electrical power systems. They can also install and maintain wiring throughout the aircraft.

Aviation Structural Mechanic (AM) – AMs maintain and repair fuselage, wings, tail, landing gear, and hydraulic systems.

Aviation Structural Mechanic-Equipment (AME) – AMEs maintain and repair utility systems within the aircraft. They work on systems such as pressurization, oxygen, heating, air conditioning, and safety devices.

Aviation Ordnanceman (AO) – AOs maintain, repair, install, and operate aviation ordnance equipment. E-2 squadrons do not have an allowance for AOs.

Aviation Electronics Technician (AT) – ATs test, maintain and repair aviation radios, radar, and other electronic equipment.

The metrics required for further analysis are: Billets Authorized (BA); Navy Manning Plan (NMP), and Current on Board (COB) for each month per squadron. Billets Authorized are the billets that are funded and approved by the CNO. The Navy Manning Plan is used to determine how shortages and excesses will be distributed. By using the projected level of assets and billets authorized, the NMP determines the most equitable level of manning an activity can expect for each rate and rank. Current on Board is the number of personnel in a particular rank and rate at the date the report is constructed.

The database that stores all of the information available in the EDVR is located in Millington, TN. An email was sent to the database administrator requesting the BA, NMP, and COB for each squadron and each rate mentioned. The database administrator then extracted the data from the EDVR database and provided a text file with all of the information requested. Once the BA, NMP, and COB are separated for each rate, all of the rates are combined into a metric for all maintainers' BA, NMP, and COB.

The manpower data for BA and COB within eRIIP is not used because there are some months where there are missing data. Values of metrics contained in both EDVR and eRIIP agree.

6. ELAR Metrics

ETS Local Assist Requests (ELAR) metrics are available through the NATEC website with the use of a CAC card at https://www.natec.navy.mil. ELAR is a database that is used to document day-to-day customer demand for Fleet and Reserve Tech Rep Services. Records in ELAR correspond to instances of technical assistance, or tech assists, provided by a Tech Rep. Some of the fields that are included for each assist are start date; end date; squadron; description; outcome; Tech Rep; Hours; and many more. For the purpose of this thesis, the total hours of assists per month per squadron and number of assists per month for each squadron are used. Data for FY-05 and FY-06 are downloaded through the NATEC website to an EXCEL spreadsheet for further analysis. Data prior to FY-05 is not used because the squadron field contains mostly missing values.

For the purpose of this thesis, only tech assists directly related to a specific squadron are used to analyze the relationship between tech assists and squadron's performance metrics. It is possible that tech assists to AIMD as well as other tech assists that are not directly related to a specific squadron might, and probably do, have an affect on squadron performance metrics and should be considered for future analysis.

Some problems with the data downloaded are that the squadron field is entered manually rather than with a dropdown menu. Multiple squadrons are

sometimes listed for one ELAR. Without a dropdown menu, the squadron field contains many variations for squadron identification. For example, "VAW-112," "VAW 112," and "VAW112" are all the same squadron. To overcome this discrepancy, a new column is added to the spreadsheet and a single format is used to identify each squadron. When multiple squadrons are listed by squadron within an ELAR assist, the ELAR is repeated for the number of squadrons listed and in the new squadron column the squadrons are listed separately. This allowed the hours and number of assists per month to be included for each squadron.

There are also inputs in the squadron field such as "all," "all local activities," or "all Hornet activity." There is no way to tell which squadrons were actually visited because some squadrons might be deployed, on exercises away from their home base, or too busy to meet with the Tech Rep. Within those ELAR assists, the hours field is a combined time for all the squadrons visited. This is often done with morning rounds to check on training and tech assist needs. If there is a technical question answered or a short assist for a particular squadron, the assist would not be captured in the all-encompassing ELAR. Assists like this in the FA-18 squadrons accounted for over 160 assists out of 1553 and 1475.5 hours out of 12,023. Because they can not be assigned to specific squadrons, they are not used in this analysis. A policy that might be considered for immediate implementation would be to have a separate ELAR for each squadron visited. If no technical assistance was given, then it should be documented in the Problem Type field as "morning rounds" so that this activity can be accounted for.

The numbers of hours for an assist that covers more than one month are not separated by the hours within each month. It is recommended that future versions of ELAR have the ability to capture the number of hours that are actually used each month for each assist. For this analysis, separate columns for each month are added to the EXCEL spreadsheet from September 2004 through October 2006. For each assist, the following are computed: average hours per day; and number of days of the assist in each month between the start and end

dates. Then for each month of an assist, the number of hours for the assist is computed by multiplying the hours per day by the number of days within that month that covered the ELAR assist.

The EXCEL spreadsheet is imported into MS ACCESS and queries are developed to total the hours per month for each squadron. The number of assists per month is computed after the hours are computed for each month. An assist spanning, say, three months will be counted in each of the three months.

D. COMPILATION OF DATA

Table 4 summarizes the metrics and the sources of data that are used for further analysis. These metrics are computed for 11 E-2C squadrons and 37 FA-18 squadrons for FY-05 and FY-06. For use in this thesis, values for these metrics are combined into a single EXCEL spreadsheet with a row for values of the metrics for each squadron for each month. Included in the spreadsheet are a column indicating squadron and a second column indicating month and year.

Data Source	Metric
AFAST Cockpit Charts	Expended AFM
	Expended AIMD AFM
	Expended AVDLR
	Expended Fuel
	Expended Overhead AFM
	Expended Squadron AFM
	Flight Hours
	Planned AFM
	Planned AVDLR
	Planned Fuel
	Squadron Number
	Squadron UIC
	TM
	TMS
	Year Month
AFAST Type Wing Tools	NMCS/PMCS Requisitions
	Non-NMCS/PMCS Requisitions
	Percent First Day Issue of NMCS/PMCS
CNAF	Coast
	FRTP Month (R+ Month)
	FRTP Phase (R+ Phase)
ELAR	Hours of Assists
	Number of Assists
eRIIP - RS&P	Flight Hour Accomplishment
	Flight Hour Entitlement
	Sortie Entitlement
eRIIP - M&SCM	ACFT in Service
	ACFT Inventory
	Cannibalizations (Canns)
	Canns per 100 Flight Hours
	Canns per 100 Flight Hours Entitlement
	Days in Month
	Depot Cycle Time (dCT)
	Direct Maintenance Man Hour (DMMH)
	DMMH per Flight Hour
	Equipment in Service (EIS) Hours
	Flight Hours per Non Mission Capable (NMC) Event
	Hours in Month
	Non-Depot in-Work Aircraft (Non Depot WIP)
	NMC Events
	NMC Hours
	NMC Rate
	Ready for Tasking
	Ready for Tasking Entitlement
	Througput
	Trained Manpower per DNEC
EDVR	BA, NMP, and COB for the following rates: AD, AE, AM, AME, AO, and AT
	Combined totals for BA, NMP, and COB

Table 4. Metrics and their Sources

III. EXPLORATORY ANALYSIS

A. INTRODUCTION

In this chapter, the objective is to describe the data and to identify relationships between different metrics for E-2C and FA-18 squadrons. Emphasis is given to analyzing the FRTP Months and Tech Rep usage compared to other metrics to identify trends between squadrons and coast.

Numerous boxplots and scatterplots are constructed using the FRTP Month, FRTP Phase, Tech Rep Hours, or Tech Rep usage (Count). The FRTP Month or Phase is used to identify trends within the variable depending upon what month or phase of the FRTP a squadron is in. Tech Rep Hours and Tech Rep usage are used in an attempt to get a better understanding of when and under what conditions Tech Rep usage is high. Differences between coasts and squadrons are also explored.

All plots are constructed for both E-2C squadrons and FA-18 squadrons. If both are not included in this Chapter, the corresponding plot will be included in Appendix B.

An initial analysis of the variables identify that training squadrons, squadrons that are not in the 27-Month FRTP, and squadrons that belong to Carrier Air Wing Five (CVW-5) have deployment patterns or other features which are very different than the other squadrons. The training squadrons (VAW-120, VFA-106C/D, VFA-106E/F, VFA-122, and VFA-125) have a large number of aircraft and never deploy. By contrast, CVW-5 is the Kitty Hawk Carrier Air Wing stationed in Japan. It is always on call (either in the Intermediate or Deployment Phase of the FRTP) and ready to deploy at a moment's notice. The FA-18E/F squadrons listed here are also different than FA-18C/D squadrons because they are still relatively new and their technical services are under contract with Boeing. Because of limited or no connection to Tech Reps, no measurable effect of Tech Rep usage can for those squadrons be obtained. FA-18E/F squadrons are

therefore not used for further analysis unless specifically identified. A list of remaining squadrons that are used for further analysis is provided in Table 5.

FA-18 Squadrons		**E-2C Squadrons**
East Coast	**West Coast**	**East Coast**
VFA-15	VFA-25	~~VAW-121~~ Removed after further analysis
VFA-34	VFA-34	VAW-123
VFA-37	VFA-94	VAW-124
VFA-81	VFA-97	VAW-125
VFA-82	VFA-113	VAW-126
VFA-83	VFA-146	
VFA-86	VFA-147	**West Coast**
VFA-87	VFA-151	VAW-112
VFA-105		VAW-113
VFA-131		VAW-116
VFA-136		VAW-117

Table 5. List of E-2C and FA-18C/D Squadrons Used for Analysis

B. FRTP CYCLES

The month and phase of the FRTP that a squadron is in has a large effect on many of squadron metrics and on Tech Rep usage. A better understanding of the FRTP cycles at the squadron level for both E-2C's and FA-18's is necessary for understanding relationships among the various metrics.

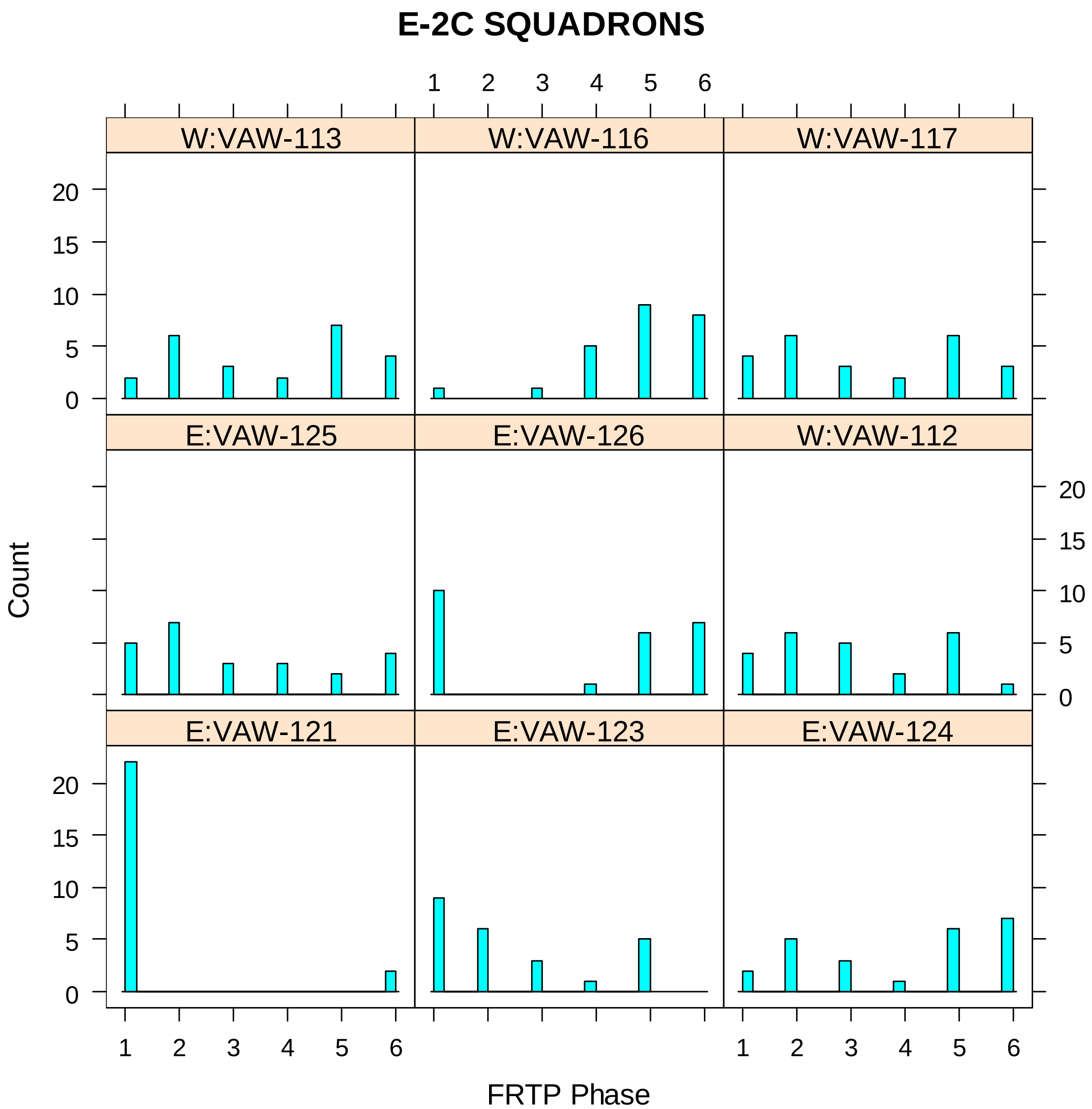

Figure 2. Histogram, Number of Months per FRTP Phase for E-2C Squadrons

Histograms of the number of months in each FRTP phases for each squadron are plotted in Figure 2 ("E" or "W" preceding the squadron number indicates that the squadron is assigned on the east or west coast respectively). VAW-121, with the exception of two months spent in Surge 2, spent all of its time in the Maintenance Phase. It is believed that VAW-121 was assigned to a carrier in an extended overhaul, which explains why the squadron spent most of the two-year period in the Maintenance Phase. Because VAW-121 is very different from the other squadrons, with respect to the distribution of Tech Rep usage, it is

not used in subsequent analysis. In addition, it is important to note that VAW-123 and VAW-126 spent twice as many months in the Maintenance Phase as other squadrons.

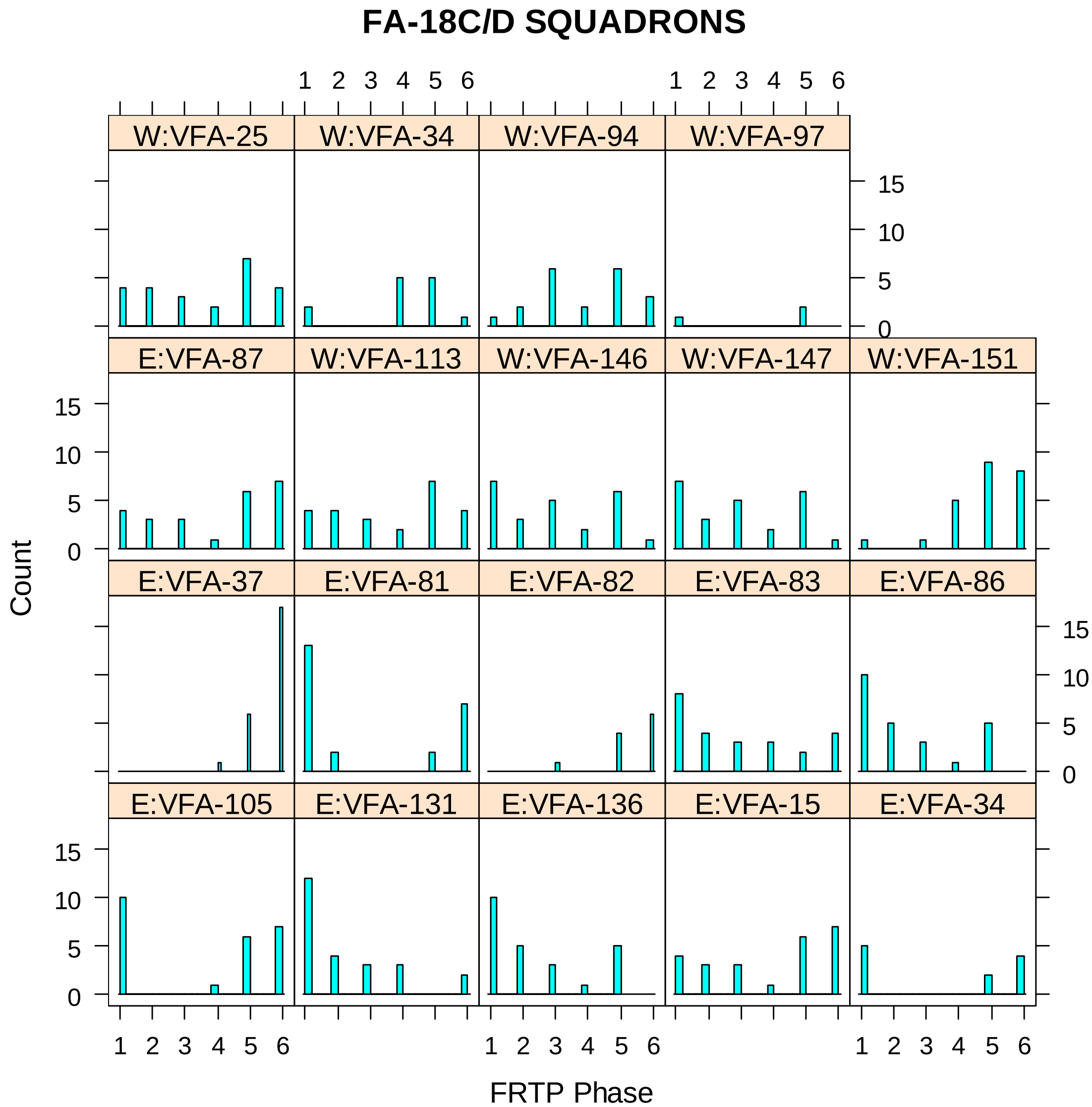

Figure 3. Histogram, Number of Months per FRTP Phase for FA-18C/D Squadrons

The FA-18 squadrons that have FRTP cycles which appear different than the rest (Figure 3) are: VFA-37; VFA-97; VFA-81; VFA-82; and VFA-105. Of the remaining squadrons, VFA-86, VFA-131, and VFA-136 spent twice the amount of time in the Maintenance Phase as most other squadrons. Squadron VFA-34 is

different in that in FY-05 it was assigned to an East Coast CVW and starting in September 2005 through FY-06 it has been assigned to a West Coast CVW. Squadrons VFA-146 and VFA-147 were in POM2, the first month of Surge 2 Phase, for one month and then proceeded to an extended Maintenance Phase (seven months). Squadron VFA-151 went from Surge 2 directly into Surge 1 Phase. Squadron VFA-136 has gone through a somewhat normal FRTP cycle, with the exceptions that it has an extended Maintenance Phase, and it has not had a chance to go into the Surge 2 Phase. Along with the extended Maintenance Phase, squadron VFA-86 went from the Intermediate Phase to one month in POM 1 in Surge 1 Phase and then to the Deployment Phase.

C. MAINTAINERS

There are two metrics pertaining to maintainers' manpower: total COB and Manpower Percent DNEC. Both may be factors in explaining differences within a squadron's performance metrics and differences in Tech Rep usage.

1. COB

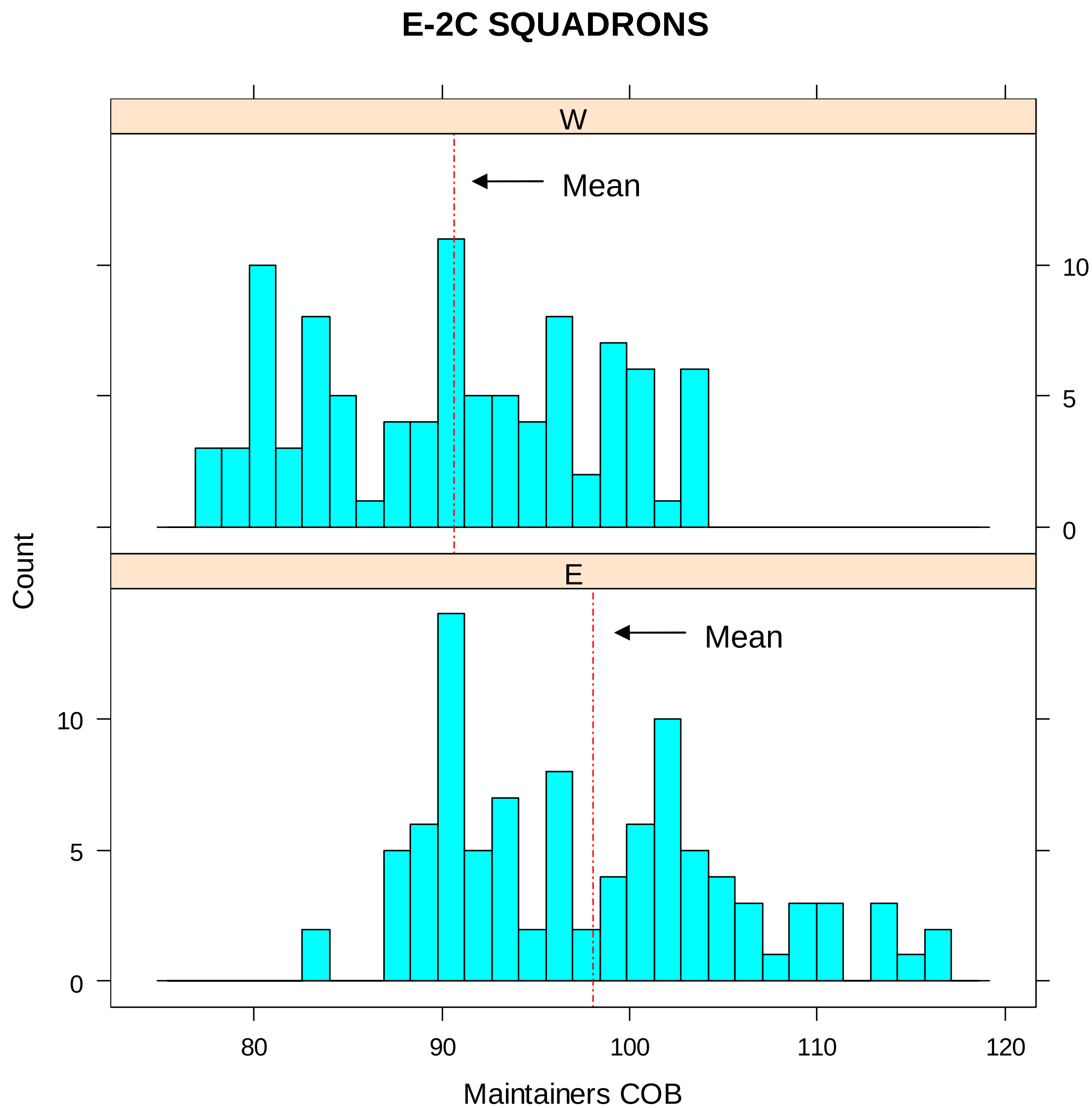

Figure 4. Histogram, Number of Maintainers per Month for E-2C Squadrons by Coast

There is a clear difference in the distribution of Maintainers COB for E-2C East Coast squadrons compared to that of the West Coast Squadrons (Figure 4). East Coast Squadrons have better manning levels with respect to the total numbers of maintainers compared to the manning level of the West Coast. As indicated in Figure 4, the mean manning level per month is 98.2 for East Coast squadrons compared to a mean manning level of 90.6 for West Coast squadrons.

The distributions of COB per month per squadron for East and West Coast FA-18C/D squadrons are fairly similar (see Figure 39 in Appendix B). The mean COB are 140.8 and 145.0 respectively for East and West Coast squadrons. Note that this comparison is based on 11 East Coast squadrons and only eight West Coast squadrons.

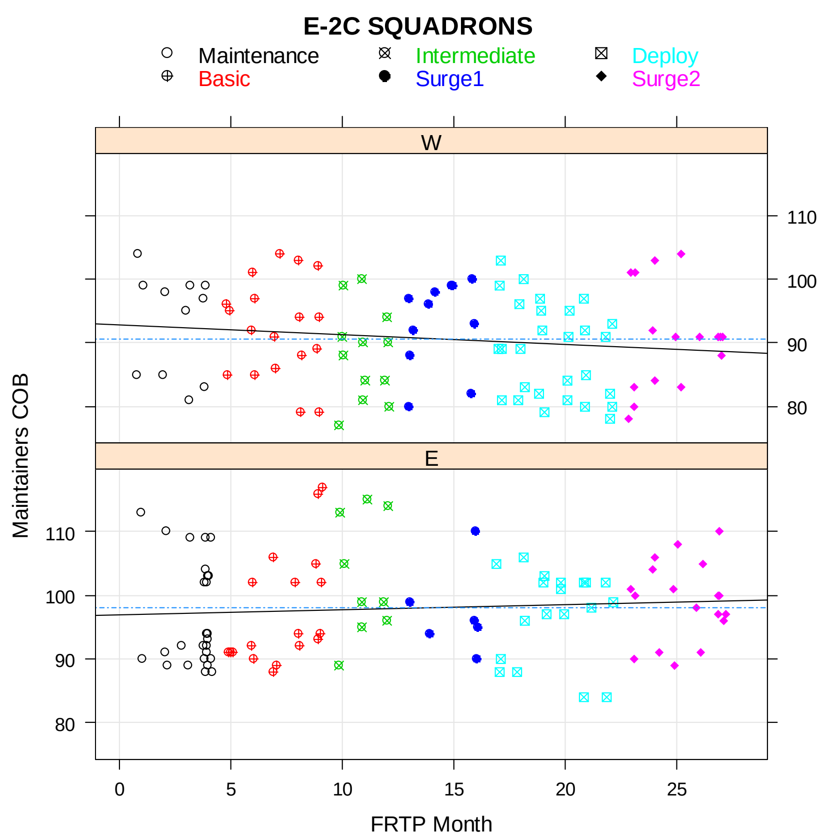

Figure 5. Maintainers COB compared to FRTP Month for E-2C Squadrons by Coast

Figure 5, for E-2C's, plots the Maintainers COB against FRTP month for each coast. For the two-year cycle under consideration, East Coast squadrons spent more time in the Maintenance Phase and less time in the Surge 1 Phase than did West Coast squadrons. The variability of Maintainer COB across FRTP month is similar for both coasts. A regression line in Figure 5 for Maintainer COB versus FRTP Month for each coast shows little general trend in Maintainer COB over the 27-month FRTP cycle. However, East Coast squadrons show an increase in Maintainers COB during the Basic Phase, with a slight decrease through Intermediate and Surge 1 Phases and then Maintainer COB appears to remain consistent though the Deploy and Surge 2 Phases. West Coast squadrons' Maintainer COB appear to be decreasing in the Intermediate Phase, Increasing in Surge 1 Phase, decreasing throughout Deployment, and then show a slight increase during the Surge 2 Phase.

Comparing East and West Coast Maintainer COB for the FA-18C/D squadrons (Figure 40 in Appendix B), there is very little general trend over the 27-month FRTP cycle. There are also no visible patterns within phases except that it appears that East Coast Squadrons are better manned during deployment than are West Coast Squadrons. The variability of Maintainers COB between coasts is similar with the East Coast squadrons showing slightly more variability. This might be accounted for by the greater number of squadrons located on the East Coast.

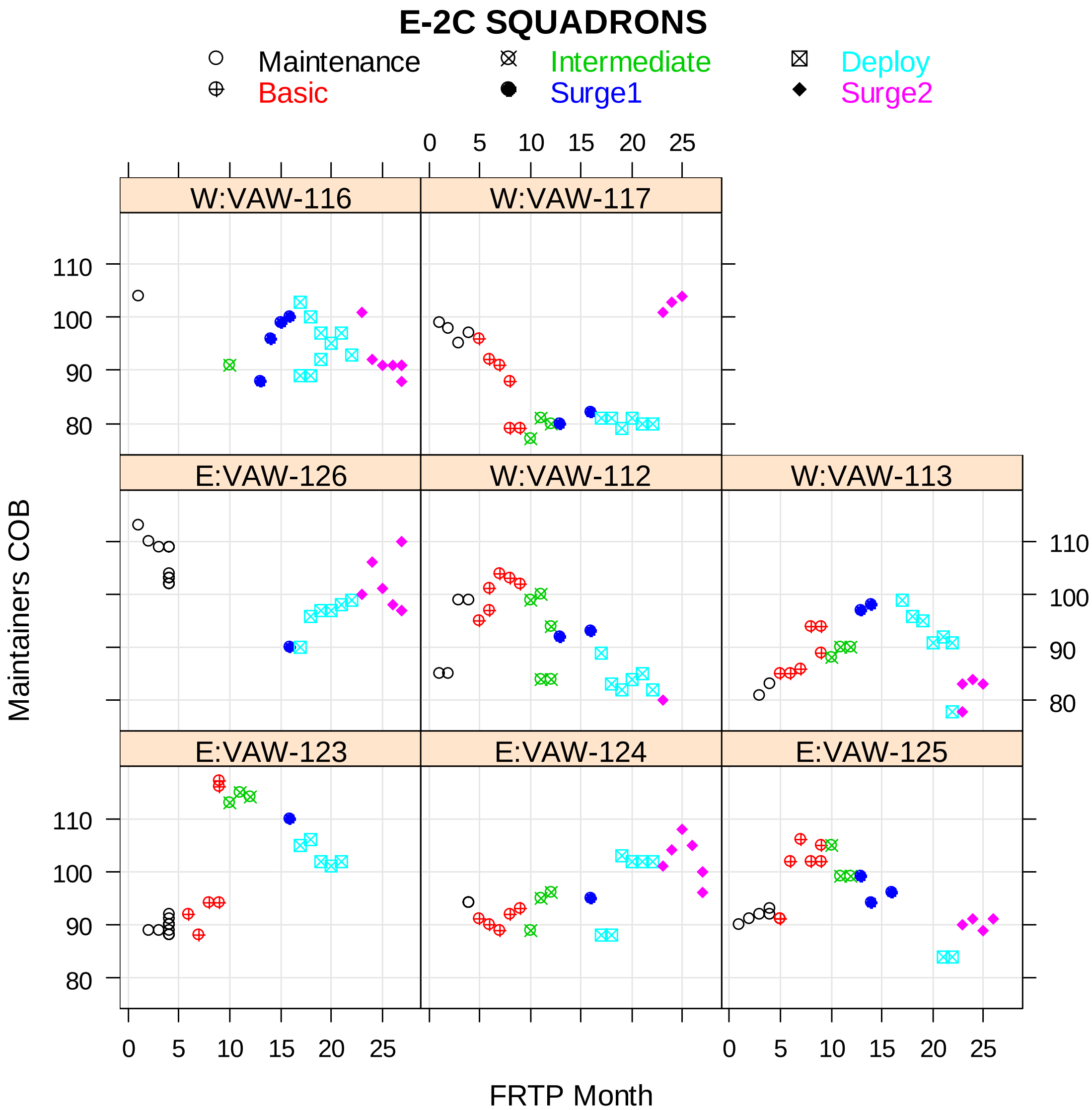

Figure 6. Maintainers COB compared to FRTP Month for each E-2C Squadron

Maintainers COB plotted against FRTP month for each E-2C Squadron (Figure 6) shows numerous different trends. The FRTP cycle that a squadron is in for the first month of the analysis, October 2004, has an effect on how these plots might be interpreted. As an example, although it might appear from Figure 6, that VAW-123 was in Basic Phase in October 2004, it actually started in the Maintenance Phase. Between Basic and Maintenance Phase, its COB jumped from 94 to 117 maintainers. VAW-112, VAW-123, and VAW-125 show a similar pattern in that they have a decreasing trend in Maintainer COB by month starting

in the Basic Phase all the way through the Deployment Phase. Only VAW-124 and VAW-126 have an increasing trend during the Deployment Phase. Another important, and somewhat surprising, observation is that three of eight squadrons have their lowest manning levels while on deployment.

Comparing Maintainers COB for FA-18C/D squadrons by month (Figure 41 in Appendix B), there do not appear to be any similar cycles among the squadrons. However, squadrons VFA-37, VFA-94, VFA-105, VFA-113, and VFA-151 all have a decreasing trend in Maintainer COB by month during deployment. As with E-2C squadrons, almost one-third (six of 19) FA-18C/D squadrons have their lowest manning during deployment.

2. Manpower Percent DNEC

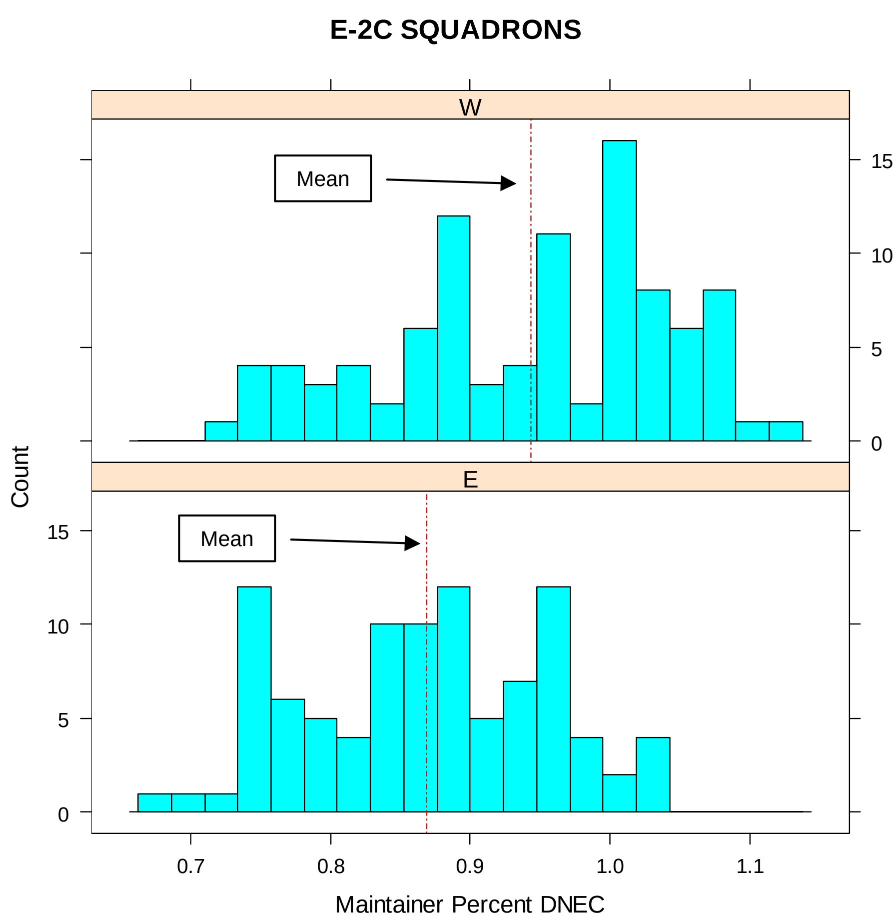

Figure 7. Histogram, Manpower Percent DNEC per Month for E-2C squadrons by Coast

There is a clear difference in the distributions of Manpower Percent DNEC for East Coast squadrons compared to those of the West Coast squadrons (Figure 7). In contrast to the distributions of Maintainers COB (Figure 4), West Coast squadrons have higher levels of maintainers with the required DNEC compared than East Coast squadrons, on average. As indicated in Figure 7, the mean Manpower Percent DNEC per month is 0.869 for East Coast squadrons compared to a mean Manpower Percent DNEC of 0.943 for West Coast squadrons.

The distributions of Manpower Percent DNEC per month for East and West Coast FA-18C/D squadrons are somewhat similar (see Figure 42 in Appendix B). As with West Coast E-2C squadrons, West Coast FA-18C/D squadrons have a higher mean than East Coast squadrons, 0.894 and 0.809 respectively.

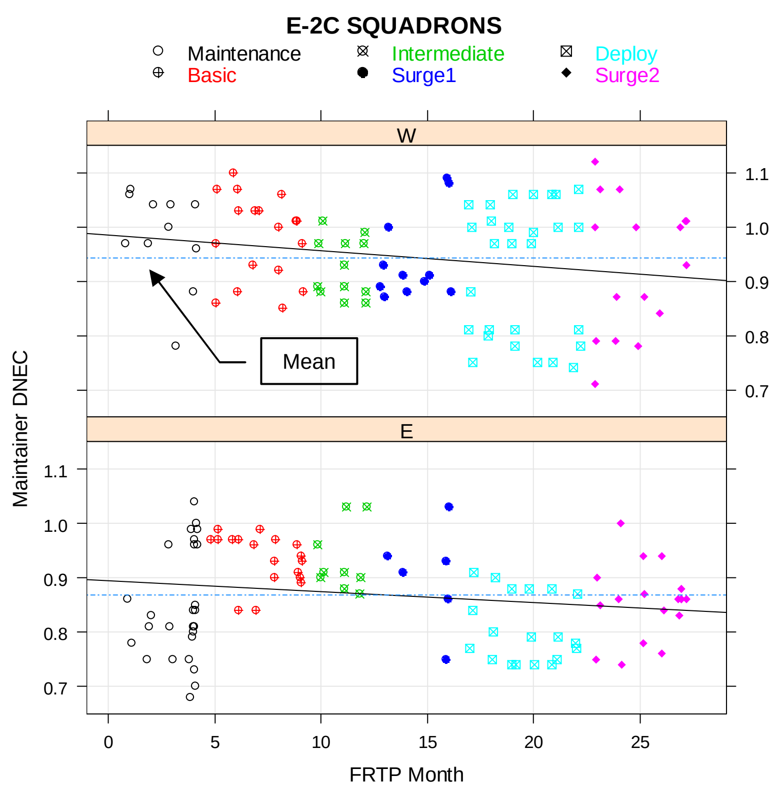

Figure 8. Manpower Percent DNEC compared to FRTP Month for E-2C Squadrons by Coast

Figure 8, for E-2C's, plots the Maintainer Percent DNEC against FRTP month for each coast. For the two-year cycle under consideration, East Coast squadrons are above their mean for Manpower Percent DNEC during most of Basic, Intermediate, and Surge 1 Phases. During the Deployment Phase, the squadrons are mostly below their mean. For West Coast squadrons, variability of Manpower Percent DNEC is roughly constant for above and below their mean during all phases of the FRTP. A regression line in Figure 8 for Manpower Percent DNEC versus FRTP Month for each coast shows little general trend in Manpower Percent DNEC over the 27-month FRTP cycle.

Comparing East and West Coast Manpower Percent DNEC for the FA-18C/D squadrons (Figure 43 in Appendix B), there is very little general trend over the 27-month FRTP cycle. There are also no visible patterns within phases. The variability of Manpower Percent DNEC between coasts is similar with the West Coast squadrons showing more variability.

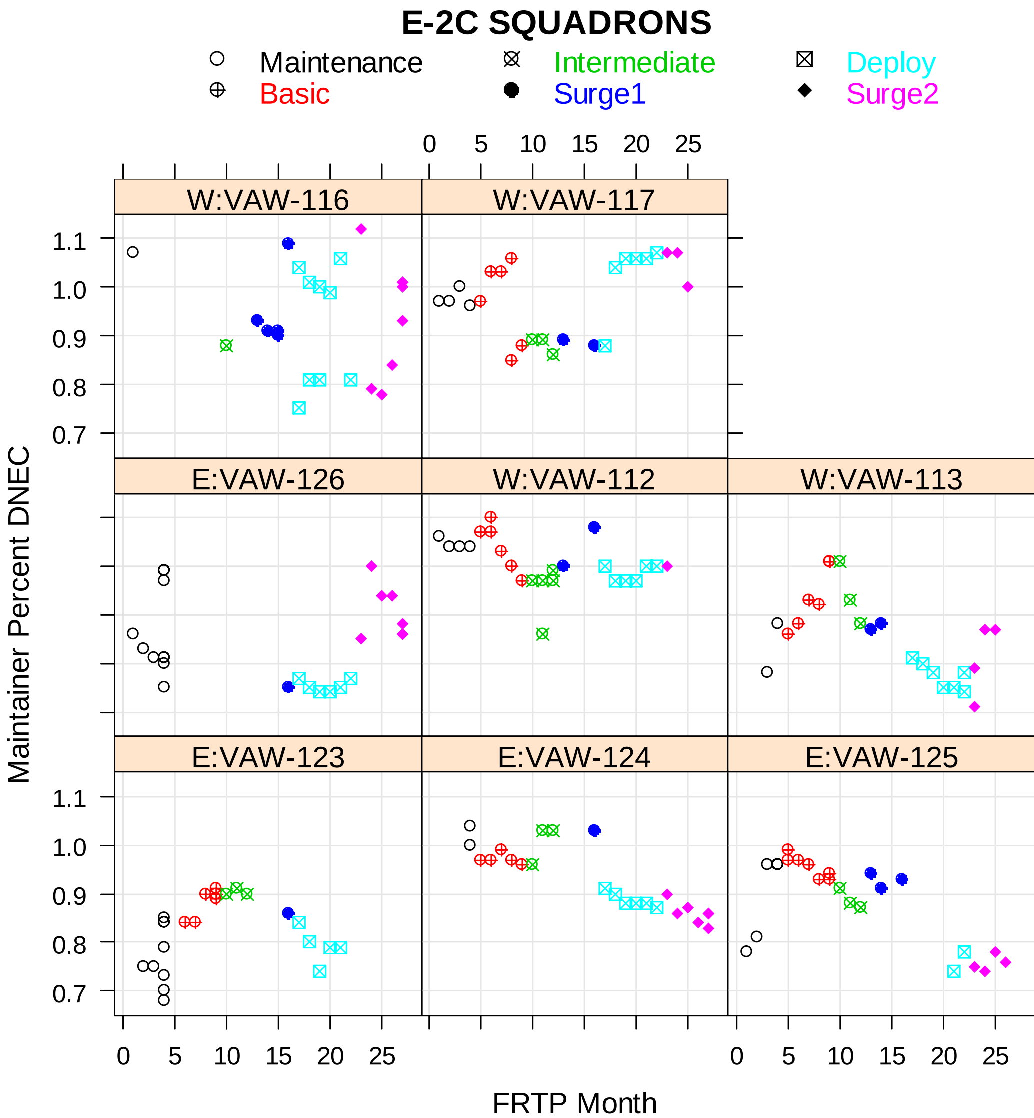

Figure 9. Manpower Percent DNEC compared to FRTP Month for each E-2C Squadron

Maintainer Percent DNEC plotted against FRTP month for each E-2C Squadron (Figure 9) shows numerous different trends. No two of the nine squadrons show similar patterns across all of the six FRTP Phases.

There is little similarity in Manpower Percent DNEC for FA-18C/D squadrons by month (Figure 44 in Appendix B). During the Deployment Phase, nearly one-third of the squadrons (5 of 18) have a decreasing trend of Manpower Percent DNEC compared to only one squadron showing an increase of

Manpower Percent DNEC during the same phase. The remaining squadrons showed little increase or decrease in their Manpower Percent DNEC during the Deployment Phase.

D. TECH REP USAGE

The number of assists per Tech Rep for FY05 and FY06 is shown in Figure 10. Double or triple counting of assists for carryover months is not included in the counts. FA-18C/D and FA-18E/F squadrons, as well as Training Squadrons for E-2C and FA-18 squadrons, are included in the cumulative counts. It was decided to use the number of Tech Rep Assists per month in the analysis rather than the number of Tech Rep hours per month. The number of assists per month is less likely to be subjective than the number of hours of assists per month which would result in false results in the analysis.

For E-2C squadrons, there are 27 Tech Reps who conducted a total of 1462 assists recorded in ELAR for the two-year period FY-05 and FY-06. Of those, 18 Tech Reps are in Norfolk (684 assists) and nine Tech Reps are in Pt. Mugu (778 assists). There are approximately 40 aircraft located in Norfolk and 20 aircraft in Pt. Mugu. Partitioning the data further, 14 Norfolk Tech Reps completed 662 of 684 assists (96.8%) with an average of 47.3 assists per Tech Rep. For Pt. Mugu, seven Tech Reps completed 767 of the 778 assists (98.6%) with an average of 109.6 assists per Tech Rep.

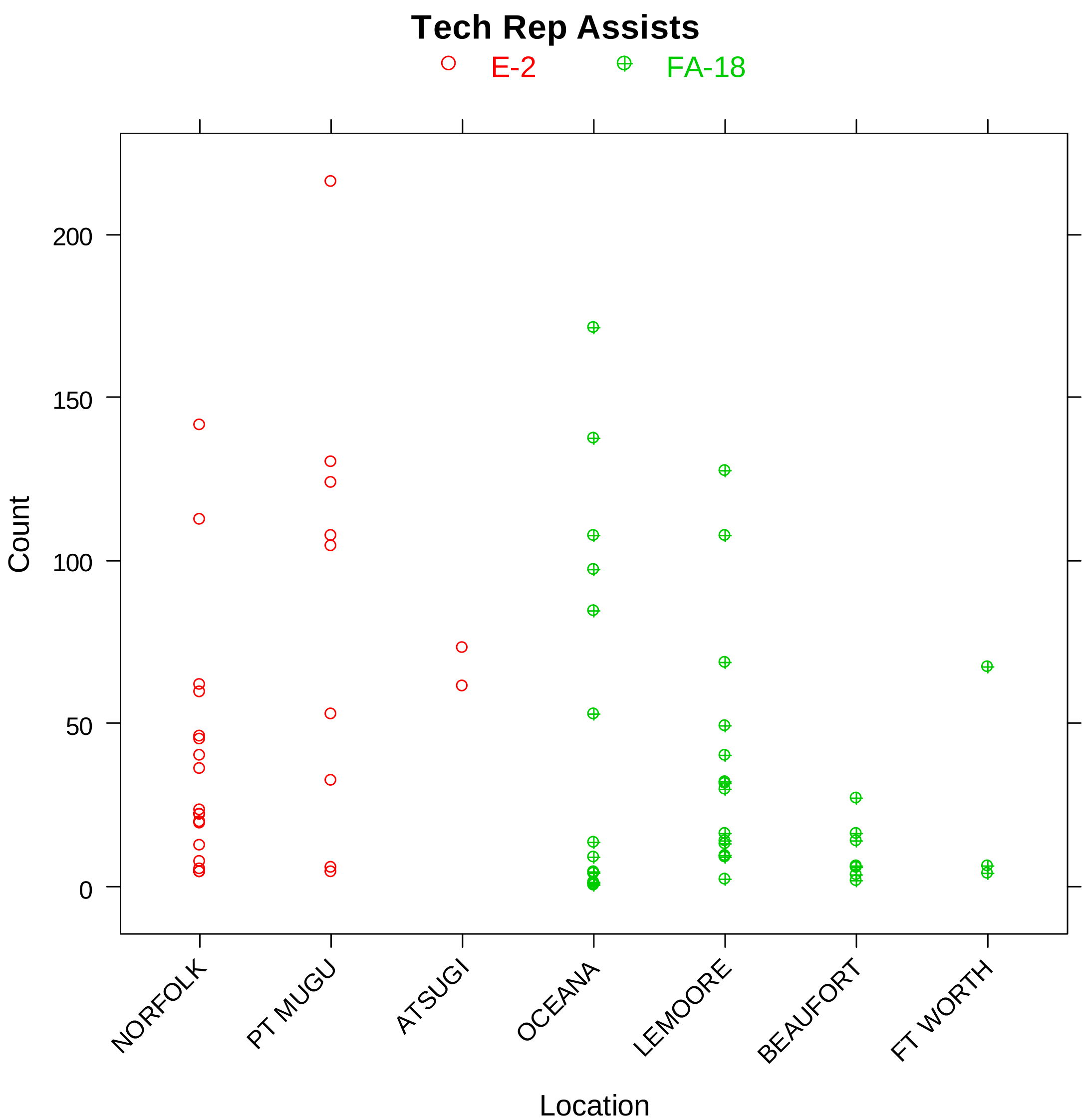

Figure 10. Count of Tech Rep Assists per Tech Rep for FY-05 & FY-06 by Platform and by Location

For FA-18 squadrons, there are 37 Tech Reps who conducted a total of 1389 assists. Of those, 13 Tech Reps are in Oceana (685 assists), 14 Tech Reps are in Lemoore (550 assists), seven Tech Reps are in Beaufort (76 assists), and three Tech Reps are in Ft. Worth (78 assists). Beaufort, SC includes VFA-82 and VFA-86 which are FA-18C/D squadrons and are included in East Coast analysis. Ft. Worth, TX includes VFA-201 and VFA-204 which are FA-18E/F squadrons. For Oceana, nine Tech Reps completed 650 of 685

assists (91.3%) with an average of 108.3 assists per Tech Rep. Lemoore has 9 Tech Reps that conducted 502 of 550 assists (91.3%) with an average of 55.8 assists per Tech Rep.

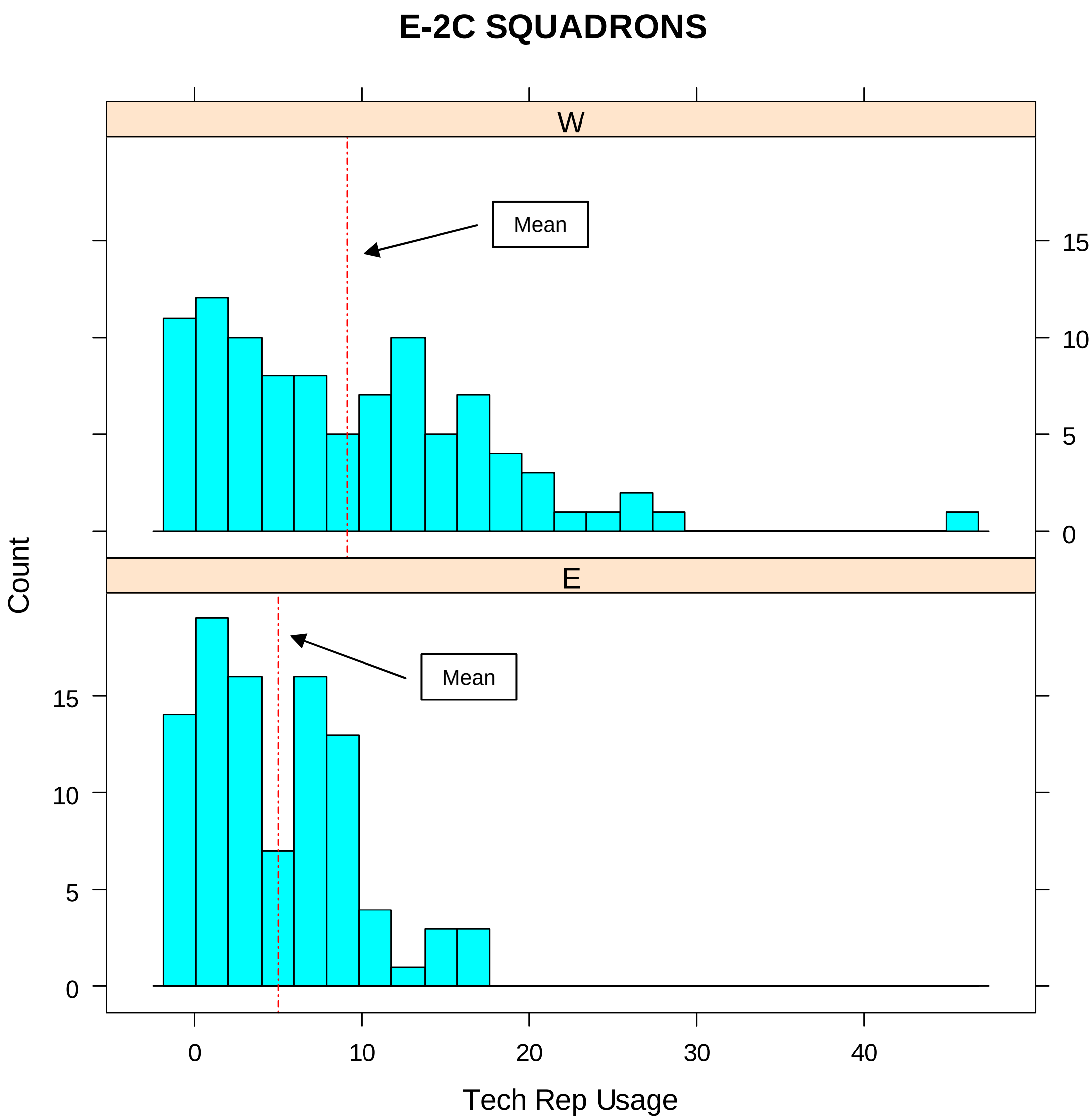

Figure 11. Histogram, Tech Rep Usage per Month for E-2C Squadrons by Coast

As seen in the histogram in Figure 11, West Coast Squadrons tend to have a higher Tech Rep usage rate per month than East Coast Squadrons. There are many possible explanations for this difference. One particular explanation could be that the West Coast has lower manning levels. The mean for East Coast is 5.00 assists per month compared to 8.73 assists per month for

West Coast Squadrons. Another way to look at the usage difference is that West Coast Squadrons have 74 percent more Tech Rep assists than the East Coast.

East and West Coast FA-18C/D squadrons have similar distributions of Tech Rep usage which can be seen in Figure 45 of Appendix B. There are more squadrons located on the East Coast, which could explain the higher Tech Rep usage for East Coast. The mean number of Tech Rep assists for East Coast Squadrons is 2.48 assists per month compared to 1.98 assists per month for West Coast Squadrons which is only a 25 percent difference.

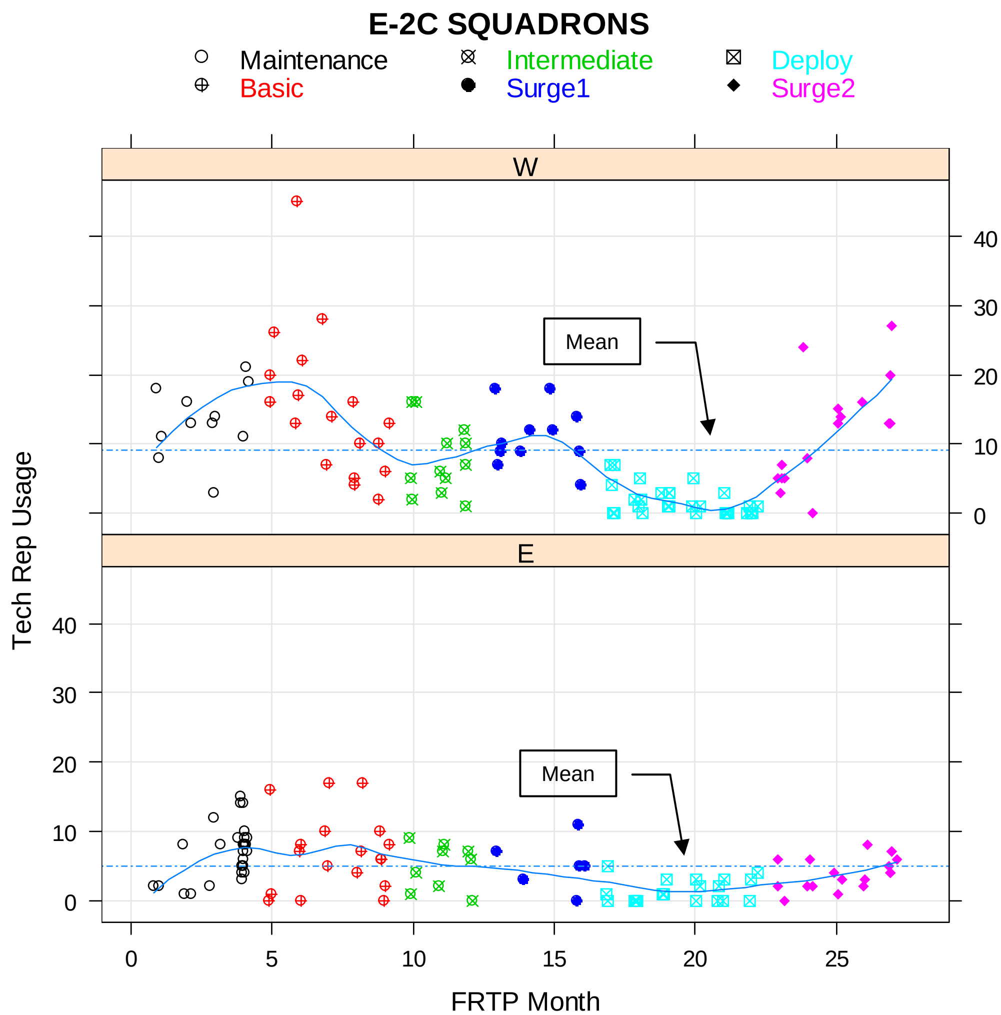

Figure 12. Tech Rep Usage compared to FRTP Month for E-2C Squadrons by Coast

When comparing Tech Rep usage to the FRTP Month (Figure 12) there is a visible cyclical trend in Tech Rep usage for West Coast Squadrons. While East Coast squadrons don't exhibit as pronounced a cyclical trend, they do have some similarities to West Coast Squadrons. They both have their greatest Tech Rep usage during the Basic Phase and their lowest Tech Rep usage during the Deployment Phase.

It may be that during the Maintenance Phase, more in-depth maintenance is conducted on the aircraft. As the end of the Maintenance Phase nears, the maintenance has to be completed to have the aircraft available for the Basic Phase when more flight training is being conducted. The decrease in Tech Rep usage during the Intermediate Phase might occur because it is during this phase that the squadron completes COMPTUEX as well as carrier air wing strike training at NAS Fallon. During these exercises, squadrons are away from their home base and have more limited access to Tech Reps. An increase at the beginning of Surge 1 Phase is when the squadrons are getting their aircraft ready for deployment and have them in the best condition possible prior to deploying. They are also required to have the aircraft ready to deploy in short notice if called upon A downward trend begins with month R+16 (also called POM1, which is Pre-Overseas Movement) which is the month prior to deployment. Not as many aircraft are required to be RFT during this month and the squadrons usually have leave periods during this time which corresponds to less maintenance being conducted. During deployment, Tech Reps do not deploy with the squadron and are rarely sent to a carrier to conduct Tech assists. Squadrons' maintainers should be at the height of their training level and most assists are completed via phone or email while on deployment. The first month back from deployment puts a squadron in the first month of Surge 2, R+23 (also called POM2 which is Post-Overseas Movement), and is similar to R+16. Once a squadron is in R+24, they are required to have their aircraft maintained at a heightened level in case they are called upon to deploy at short notice.

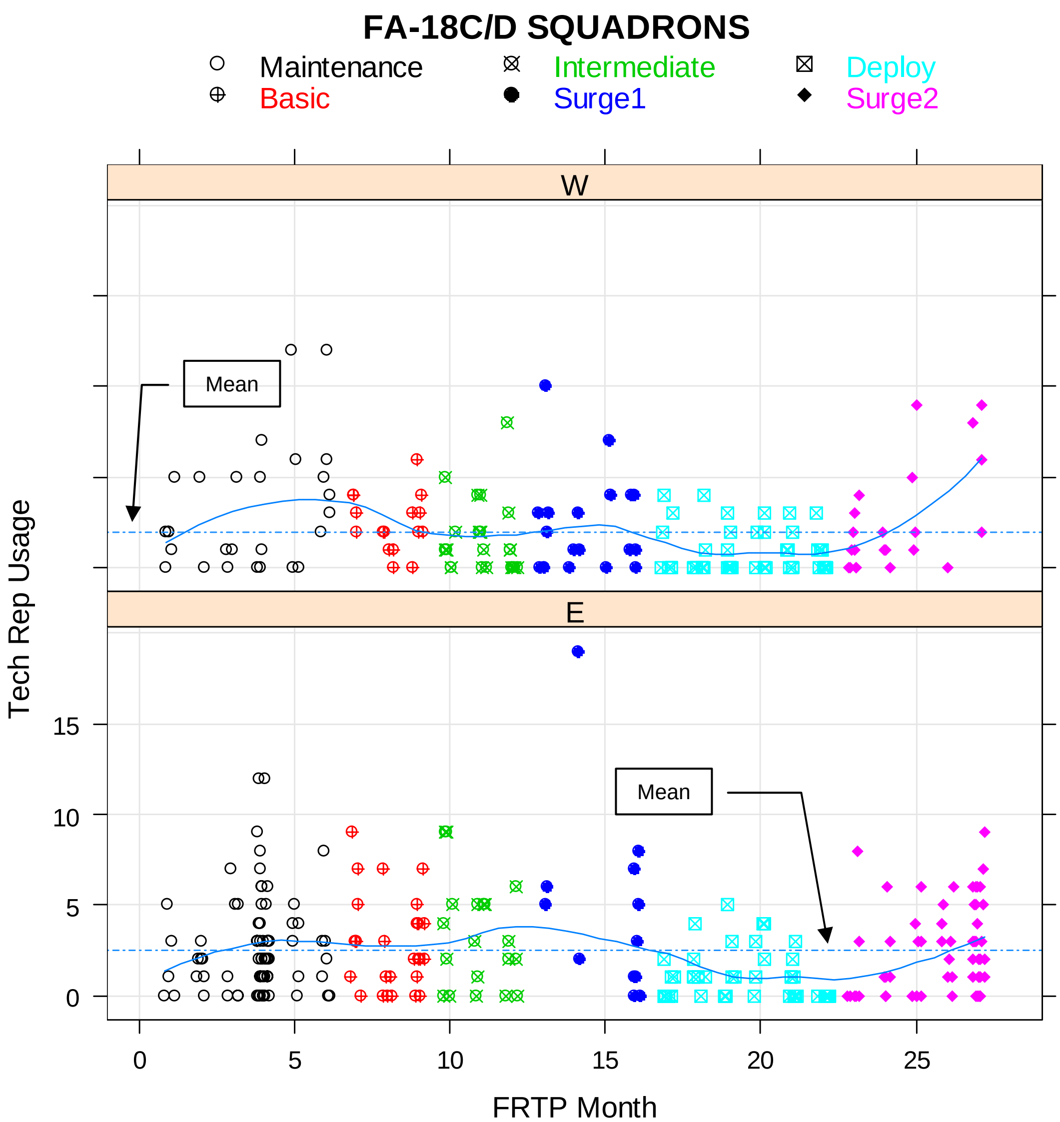

Figure 13. Tech Rep Usage compared to FRTP Month for FA-18C/D Squadrons by Coast

Tech Rep usage by FRTP Month by coast for FA-18C/D squadrons (Figure 13) shows cyclical trends similar to those in E-2C Squadrons. The trend for West Coast FA-18C/D squadrons matches almost exactly the trend for West Coast E2-C Squadrons. East Coast for E2-C and FA-18C/D squadrons also have somewhat similar trends except that the greatest Tech Rep usage for FA-18C/D squadrons does not occur until the beginning of Surge 1 Phase.

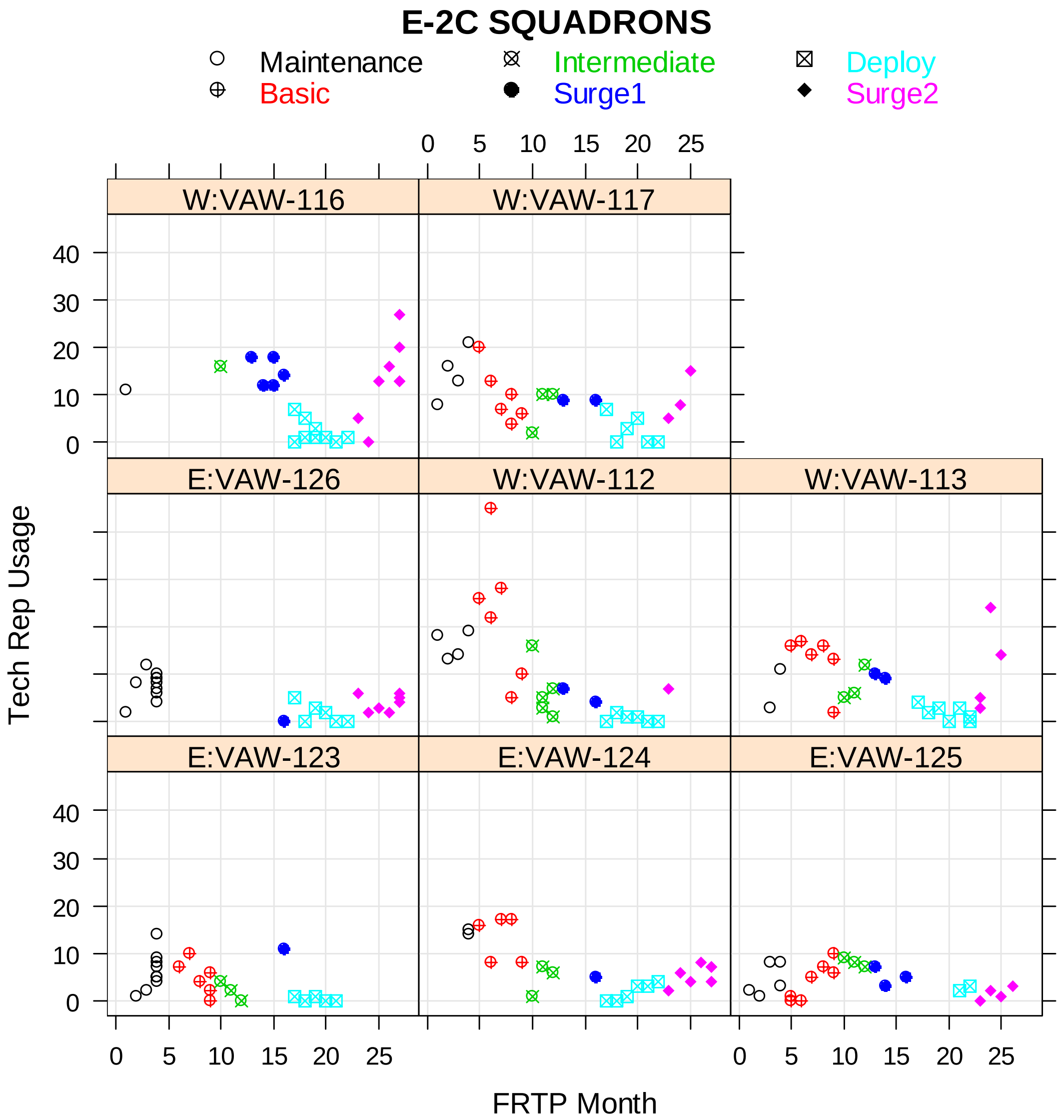

Figure 14. Tech Rep Usage compared to FRTP Month for each E-2C Squadron

Looking further into Tech Rep usage rates at the squadron level for E-2C Squadrons (Figure 14), an even better insight of when Tech Reps are used can be gained. All of the West Coast Squadrons have the similar trends to varying degrees. VAW-124 and VAW-125 also have the same pattern for Tech Rep usage as West Coast Squadrons and VAW-123 and VAW-126 don't appear to have much of any noticeable pattern.

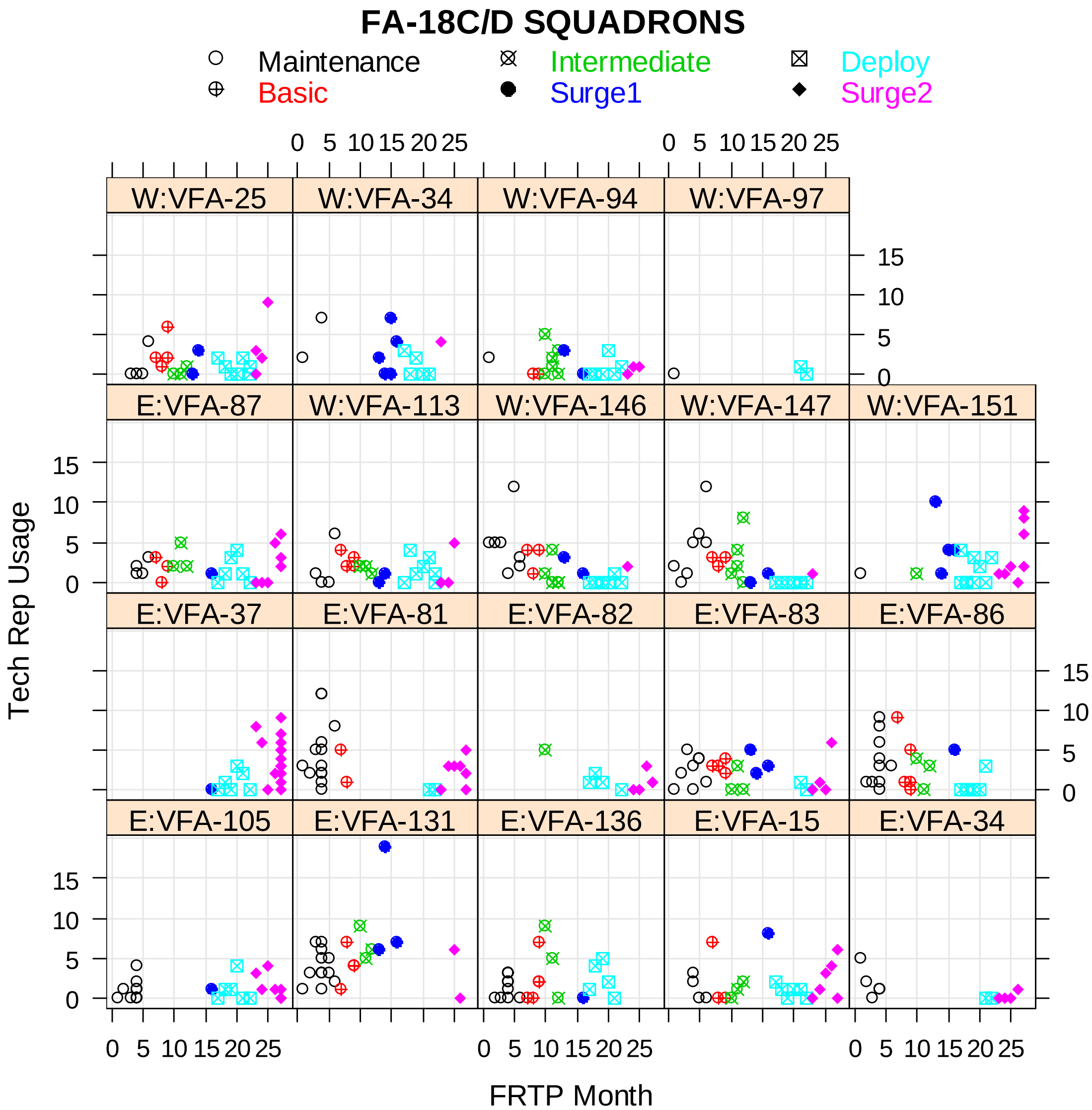

Figure 15. Tech Rep Usage compared to FRTP Month for each FA-18C/D Squadron

Tech Rep usage for FA-18C/D Squadrons at the squadron level (Figure 15) shows few patterns. VFA-151 went from Surge 2 directly into Surge 1 and therefore had more Tech Rep usage to make up for not going through a Maintenance Phase. By contrast, VFA-146 and VFA-147 went from Deployment into the Maintenance Phase. Since they bypassed Surge 2, they appear to have slightly higher Tech Rep usage during the Maintenance Phase. VFA-146 and VFA-147 are also on the same FRTP cycle and their Tech Rep usage rates are

very similar. Squadrons VFA-83 and VFA-87 appear to follow somewhat the same trend as West Coast Squadrons. VFA-15 also follows the same trend as West Coast Squadrons even though it bypassed all but one month of Surge1.

E. TECH REP USAGE COMPARED TO CANNIBALIZATIONS

After acquiring a better knowledge of Tech Rep usage, other metrics are looked at to see if they were related to Tech Rep usage. The strongest relationship between Tech Rep usage and other metrics are found with the number of Cannibalizations per month. There are very few other metrics which show relationships with Tech Rep usage.

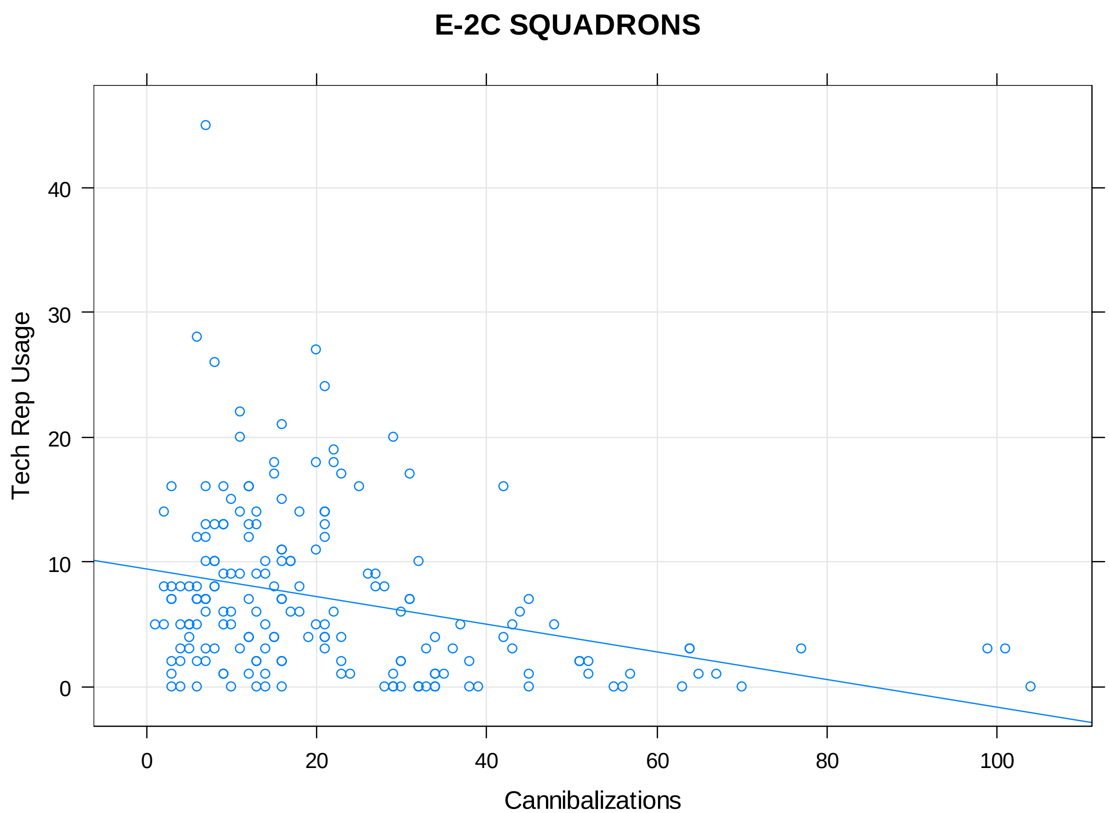

Figure 16. Tech Rep Usage compared to Cannibalizations per Month for E-2C Squadrons

Figure 16 shows the Tech Rep usage versus Cannibalizations by month for E-2C Squadrons. There appears to be an increase in the number of cannibalizations per month with a decrease in Tech Rep usage. In the same plot for FA-18C/D squadrons (Figure 46 in Appendix B), there does not appear to be

any identifiable trends. Tech Rep usage compared to Manpower Percent DNEC for E-2C Squadrons (Figure 47 in Appendix B) shows an increasing trend; that is, an increase in Manpower Percent DNEC is associated with in an increase in Tech Rep usage. The same plot of Tech Rep usage versus Manpower Percent DNEC for FA-18C/D Squadrons (Figure 48 in Appendix B) does not indicate any identifiable trends. Looking at other plots of Tech Rep usage compared to the other metrics, for E-2C and FA-18C/D squadrons, no additional relationships are identified. This indicates that there is possibly a more complex relationship among the variables that needs to be pursued.

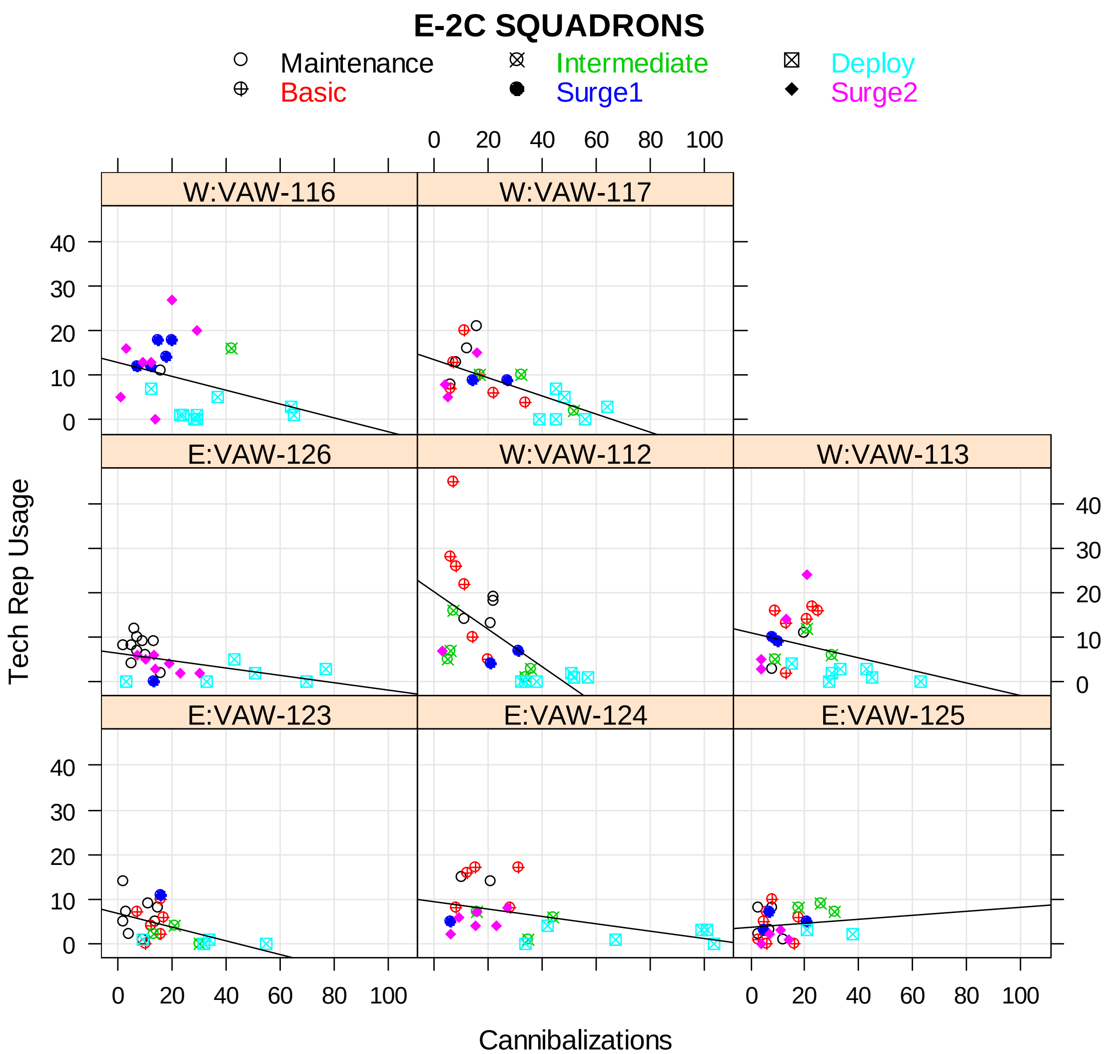

Figure 17. Tech Rep Usage compared to Cannibalizations per Month for each E-2C Squadron (with Deployment Phase)

Figure 17 plots Tech Rep usage against the number of Cannibalizations per month by squadron for E-2C Squadrons. Analyzing these plots, it appears that there is a relationship between Tech Rep usage and Cannibalizations for most squadrons. The decreasing trend indicates that as Tech Rep usage decreases, the number of Cannibalizations increases. Looking at this closer though, we know that Tech Rep usage is always lower during deployment as Tech Reps are not deployed with squadrons and are not as readily available. The number of cannibalizations is also highest during deployment as observed in Figure 17. FA-18C/D Squadrons did not show the same relationship seen with the E-2C Squadrons (Figure 49 in Appendix B). Within the FA-18C/D Squadrons, the only squadrons that indicate a relationship exists are VFA-136 and VFA-146. The number of cannibalizations per month is also highest during the deployment phase for FA-18C/D Squadrons.

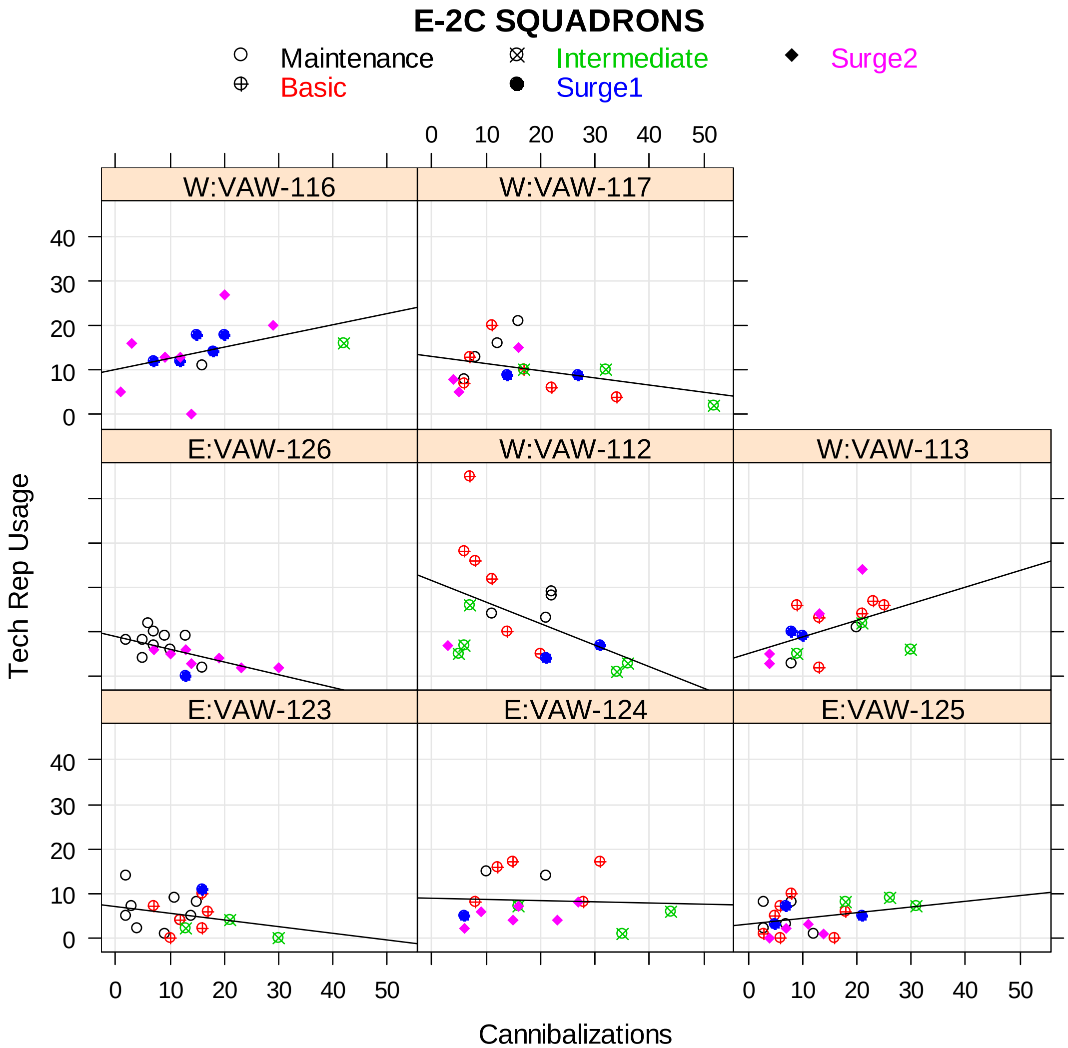

Figure 18. Tech Rep Usage compared to Cannibalizations per Month for each E-2C Squadron (without Deployment Phase)

By looking at a plot of Tech Rep usage against the number of Cannibalizations per month that takes out the Deployment Phase (Figure 18), an inverse relationship between Tech Rep usage and Cannibalizations is observed for some squadrons. With the exception of squadrons VAW-112 and VAW-126, there does not appear to be a strong relationship between Tech Rep usage and the number of Cannibalizations per month. FA-18C/D Squadrons show the same effect when taking out the Deployment Phase (Figure 50 in Appendix B). VFA-97 is excluded from this plot since it only had one observation that is not during the Deployment Phase. Care must be given with further analysis (within this thesis

and other analysis) to be extra cautious when analyzing metrics with the Deployment Phase included since that might act as a compounding variable.

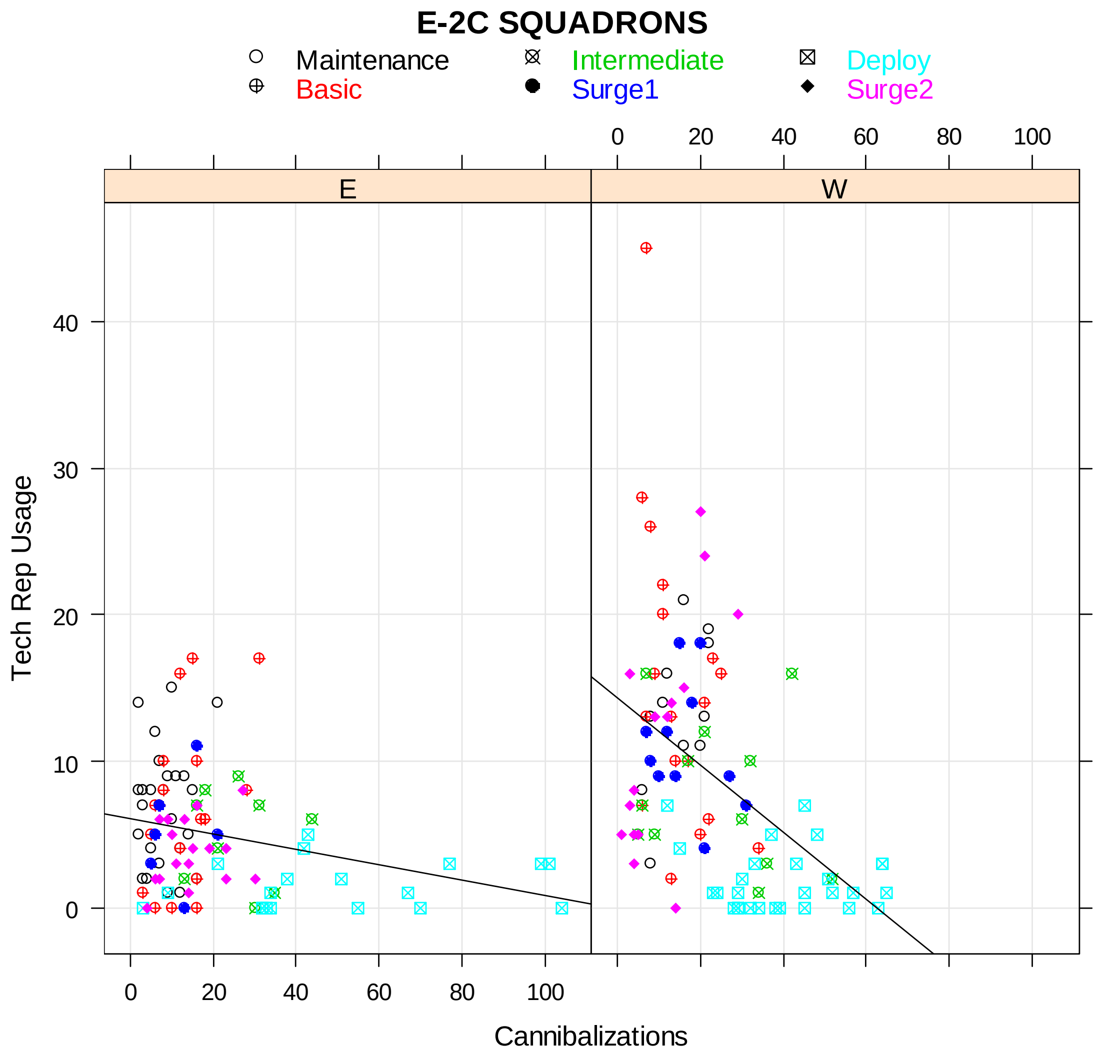

Figure 19. Tech Rep Usage compared to Cannibalizations per Month for E-2C Squadrons by Coast

Comparing East and West Coast for Tech Rep usage versus the number of Cannibalizations per month for E-2C Squadrons (Figure 19) and FA-18C/D Squadrons (Figure 51 in Appendix B), no relationship is obvious given the presence of high variability. When the Deployment Phase is taken out of the plot, there is even less evidence of relationship within the data. Analyzing Tech Rep usage compared to other metrics by Coast, no relationships are identified within the plots. This is further evidence that the relationship between Tech Rep

usage and other metrics either does not exist or that it is more complex than can be seen in these plots.

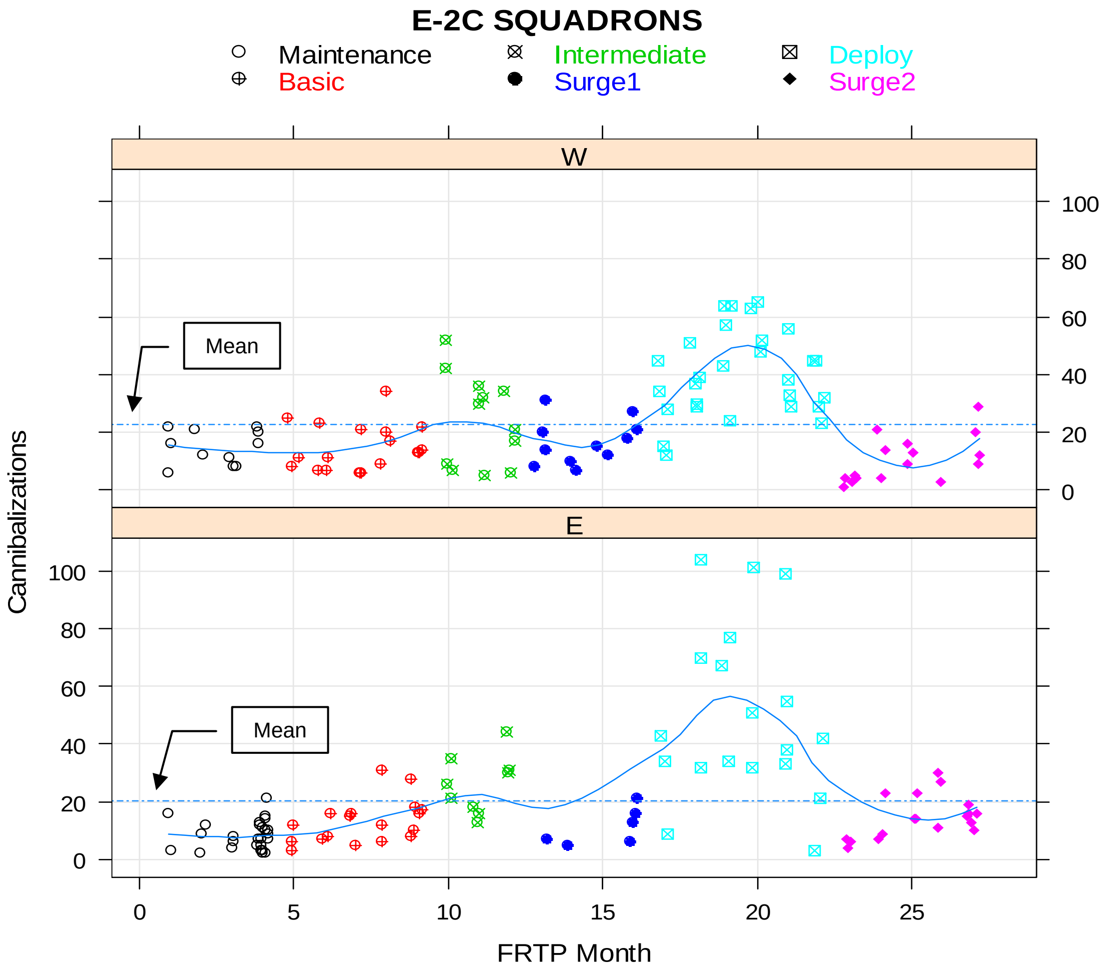

Figure 20. Cannibalizations compared to FRTP Month per Month for E-2C Squadrons by Coast

The number of cannibalizations per month is then compared to the FRTP Month for E-2C Squadrons (Figure 20) and FA-18C/D Squadrons (Figure 52 in Appendix B) to gain an understanding of how the number of cannibalizations changes throughout the FRTP cycle. This demonstrates that the month and phase of the FRTP a squadron is in has an effect on the number of cannibalizations per month. This is also observed with Tech Rep usage per month and other metrics that will be discussed. For E-2C Squadrons, there is not enough data in the Intermediate Phase for both coasts and during the Surge

1 Phase for East Coast Squadrons to indicate a trend during those phases (this will also be the case with other E-2C metrics). More data within these phases could indicate a downward trend during the Intermediate Phase and an upward trend in the Surge 1 Phase. Within the FA-18C/D Squadrons, the Surge 1 Phase for East Coast Squadrons does not have enough data to be conclusive with any trend. More data within this phase could indicate a cycle more like that of West Coast Squadrons.

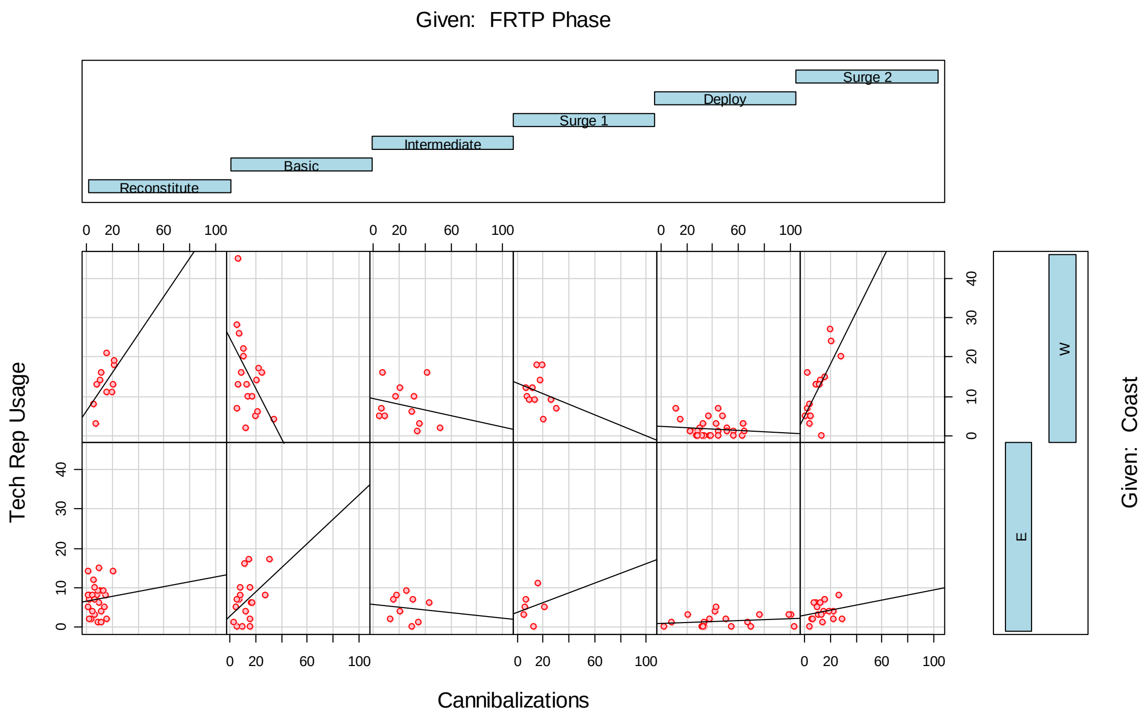

Figure 21. Cannibalizations compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

The number of cannibalizations compared to Tech Rep usage per month by Coast and FRTP Phase for E-2C Squadrons (Figure 21) and FA-18C/D Squadrons (Figure 53 in Appendix B) shows some relationships within the data. For E2-C West Coast Squadrons in the Basic Phase, it appears that as the number of cannibalizations decreases the Tech Rep usage increases. The opposite appears to be true during Phase 2 with an increase in the number of cannibalizations being associated with an increase in Tech Rep usage. The same relationship seems to exist for East Coast Squadrons in the Basic Phase.

The only relationship within FA-18C/D Squadrons is for East Coast Squadrons in the Basic Phase where a decrease in Tech Rep usage relates to an increase in the number of Cannibalizations per month.

F. OTHER METRICS COMPARED TO FRTP PHASE

Analyzing the number of Cannibalizations per month compared to the FRTP month indicates that there is a trend depending on which phase the squadron is in. Analysis of other metrics also indicates that some trends to exist within phases. Comparing the trends within the metrics to each other indicate that there are three groups within E-2C Squadrons (Table 6) that have similar trends and three groups within FA-18C/D Squadrons (Table 7) that have similar trends. For both E-2C Squadrons and FA-18C/D Squadrons, EIS Hours and Aircraft In Service measure the same thing but in different scales. NMC Hours, NMC Rate, and Non-Depot WIP are also all the same but with different scales. There are also metrics that have similar trends between E-2C and FA-18C/D Squadrons which are included in Table 8.

Group One		**Group Two**
Cannibalizations		EIS Hours
NMCS/PMCS		Aircraft In Service
Non-NMCS/PMCS		Non-Depot dCT
Maintenance Hours		Canns per 100 Flight Hours
Flight Hours per NMC Event		Maintenance Hour per Flight Hour
AVDLR		
Squadron AFM		**Group Three**
RFT - Actual		NMC Hours
NMC Events		NMC Rate
		Non Depot WIP

Table 6. FRTP Phase Trend Groupings for E-2C Squadrons

Group One		Group Two
NMC Events		EIS Hours
NMC Hours		Aircraft In Service
Cannibalizations		
Maintenance Hours		
Non Depot WIP		
Flight Hours per NMC Event		**Group Three**
NMCS/PMCS		Non-Depot dCT
Non-NMCS/PMCS		Maintenance Hour per Flight Hour
AVDLR		
Squadron AFM		
RFT - Actual		

Table 7. FRTP Phase Trend Groupings for FA-18C/D Squadrons

NMCS/PMCS	NMC Events
Non-NMCS/PMCS	Non-Depot dCT
AVDLR (West Only)	Canns
Squadron AFM	Maintenance Hours
Aircraft In Service	Maintenance Hours per Flight Hour
EIS Hours	

Table 8. Metrics that have Similar Trends for both E-2C and FA-18C/D Squadrons

1. Similar Trends, Group One (E-2C and FA-18C/D Squadrons)

Comparing the plots within Group One for E-2C squadrons and FA-18 squadrons, they both share similarities throughout the FRTP Phases. To illustrate the trends within this group, NMC Events is compared to FRTP Months for both E2-C (Figure 54 in Appendix B) and FA-18C/D (Figure 55 in Appendix B) Squadrons. Both coasts share similar trends as well. Within the Maintenance, Basic, and Intermediate Phases there is an upward trend in the number of NMC Events. Once in the Intermediate Phase there is a slight downward trend until halfway through Surge 1 Phase. For East Coast Squadrons (E-2C and FA-18C/D) the decrease is less pronounced due to a lack of data in Surge 1 Phase. Halfway through Surge 1 Phase, there is an upward trend until the metric reaches its maximum halfway through Deployment when it then begins a downward trend. The downward trend continues until the beginning of Surge 2

Phase and then begins an increase. The RFT that each squadron achieved is included in Group One and has characteristics similar to those of the other metrics within the group. This indicates that RFT may be a driving force for the metrics within Group One since there is an entitlement for RFT.

2. Similar Trends, Group Two (E-2C and FA-18C/D Squadrons)

The plots within Group Two for E-2C squadrons and FA-18 squadrons also share similarities throughout the FRTP Phases. To illustrate the trends within this group, Aircraft In Service is compared to FRTP Months for both E-2C (Figure 56 in Appendix B) and FA-18C/D (Figure 57 in Appendix B) Squadrons. Both Coasts have similar trends which show very little increase or decrease throughout the cycle. East Coast FA-18C/D squadrons do show a slight increase and decrease throughout the FRTP cycle and the variation remains constant throughout, except in R+4 and R+27 of the FRTP which are months in which squadrons are "stashed" – that is, they can remain in that particular phase for longer than what is scheduled in a normal 27-month FRTP cycle.

3. Similar Trends, Group Three (E-2C Squadrons)

As mentioned earlier, the three metrics within Group Three for E-2C Squadrons measure exactly the same thing but on different scales. Although there is really only one metric within this group, the trend is different from the rest and important to understand. This trend is illustrated by comparing Non-Depot WIP to FRTP Months (Figure 58 in Appendix B). The trends for East and West Coast are slightly different but with more data might be more similar. For West Coast Squadrons, from the Maintenance Phase until towards the end of the Deployment Phase there is a slight increase in Non-Depot WIP. The last month of Deployment shows a dip until two months into Surge 2 Phase where it increases again. For East Coast Squadrons, there is a slight dip starting in the Intermediate Phase and continuing until halfway through Surge 1 Phase. An increase is observed until halfway through Deployment and then begins to decrease all the way through Surge 2.

4. Similar Trends, Group Three (FA-18 Squadrons)

The metrics within Group Three for FA-18C/D squadrons all show similar characteristics and are illustrated by comparing Maintenance Hours per Flight Hour to FRTP Months (Figure 59 in Appendix B). Both Coasts have a similar trend which begins by being constant. There is a decrease within the Deployment Phase because the aircraft are flying for longer hours during sorties. There is then a slight increase halfway through Deployment which then begins to decrease after the first couple of months into Surge 2.

G. TECH REP USAGE COMPARED TO OTHER METRICS BY SQUADRON (WITHOUT DEPLOYMENT PHASE)

As seen earlier, including Deployment Phase in plots of Tech Rep usage compared to other Metrics by Squadron, may be misleading. To adjust for this, the Deployment Phase is taken out of the data to compare Tech Rep usage to the Other Metrics. With the Deployment Phase taken out, most metrics had only one or two squadrons that showed a relationship between Tech Rep usage and Other Metrics. With only one or two squadrons indicating a relationship, a relationship might exist within that particular squadron or it might just be noise. More data is required to determine if a relationship actually does exist. The number of Maintainers COB in a squadron did show signs of a relationship with Tech Rep usage for both E-2C (Figure 22) and FA-18 (Figure 23) Squadrons. There also appears to be a relationship between Tech Rep usage and Non-Depot WIP for E-2C Squadrons (Figure 24).

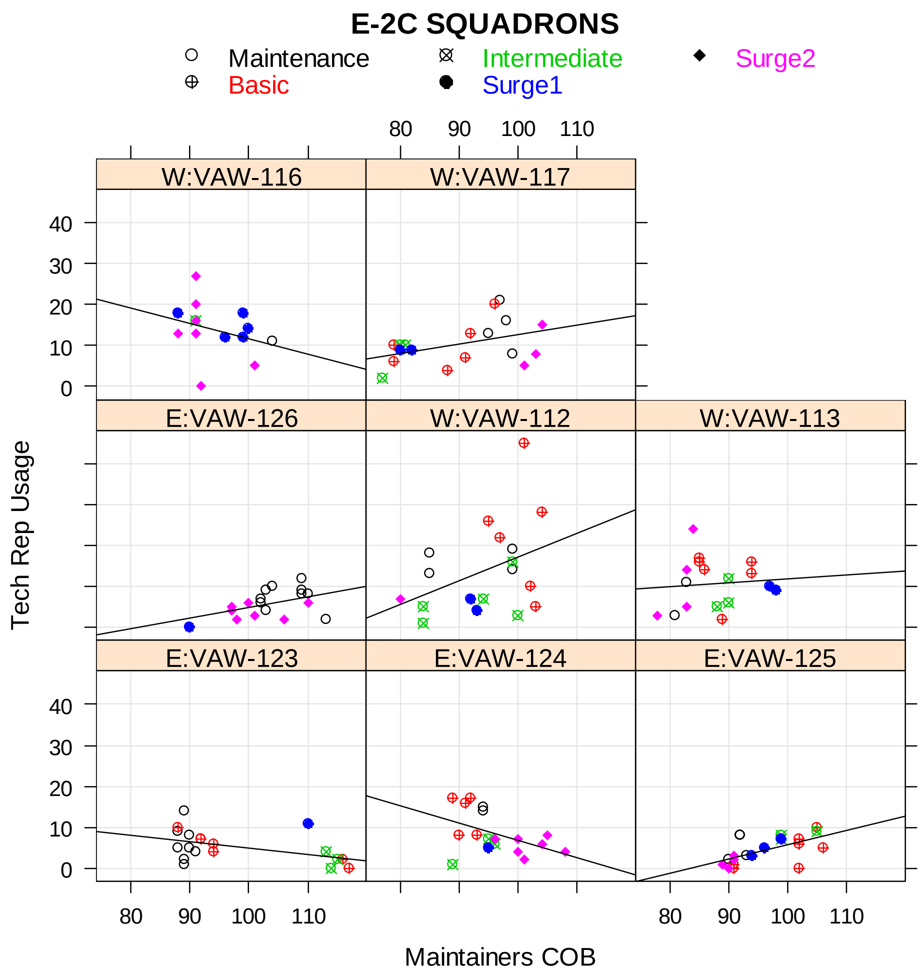

Figure 22. Tech Rep Usage compared to Maintainers COB per Month for each E-2C Squadron (without Deployment Phase)

Four of nine squadrons (44 percent) show a positive association between Tech Rep usage and Maintainers COB within E-2C Squadrons (Figure 22). This indicates that an increase in Maintainers COB relates to an increase in Tech Rep usage. For FA-18 squadrons (Figure 23), the scale for Maintainers COB was limited (zoomed-in) to between 115 and 165 to have an enhanced view of any relationship that might exist. A subset is not used so that the regression line is not affected. Of the 18 squadrons, 10 of them (56 percent) have a positive slope which also indicates that an increase in Maintainers COB relates to an increase in Tech Rep usage.

Comparing Tech Rep usage to Non-Depot WIP within E-2C Squadrons (Figure 24), four of nine squadrons (44 percent) displayed a positive slope which indicated that as Non-Depot WIP increases, Tech Rep usage also increases on average.

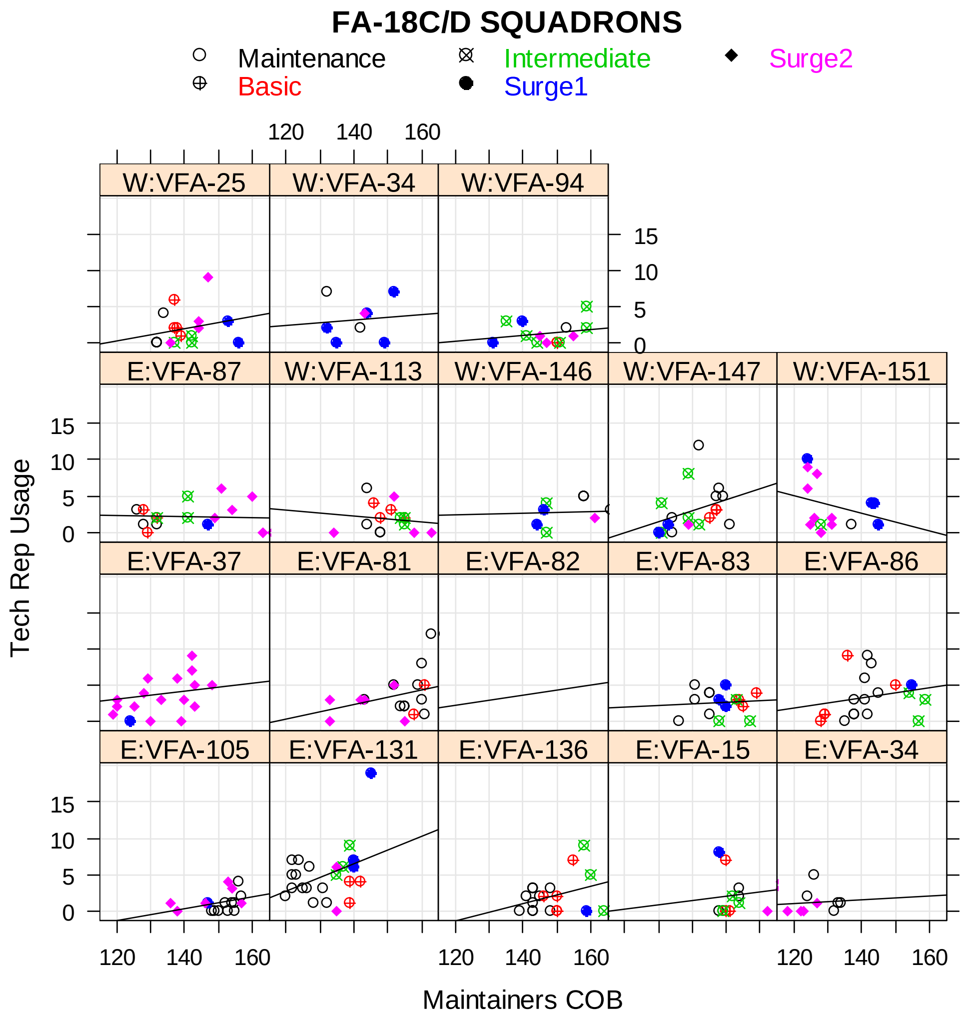

Figure 23. Tech Rep Usage compared to Maintainers COB per Month for each FA-18C/D Squadron (without Deployment Phase)

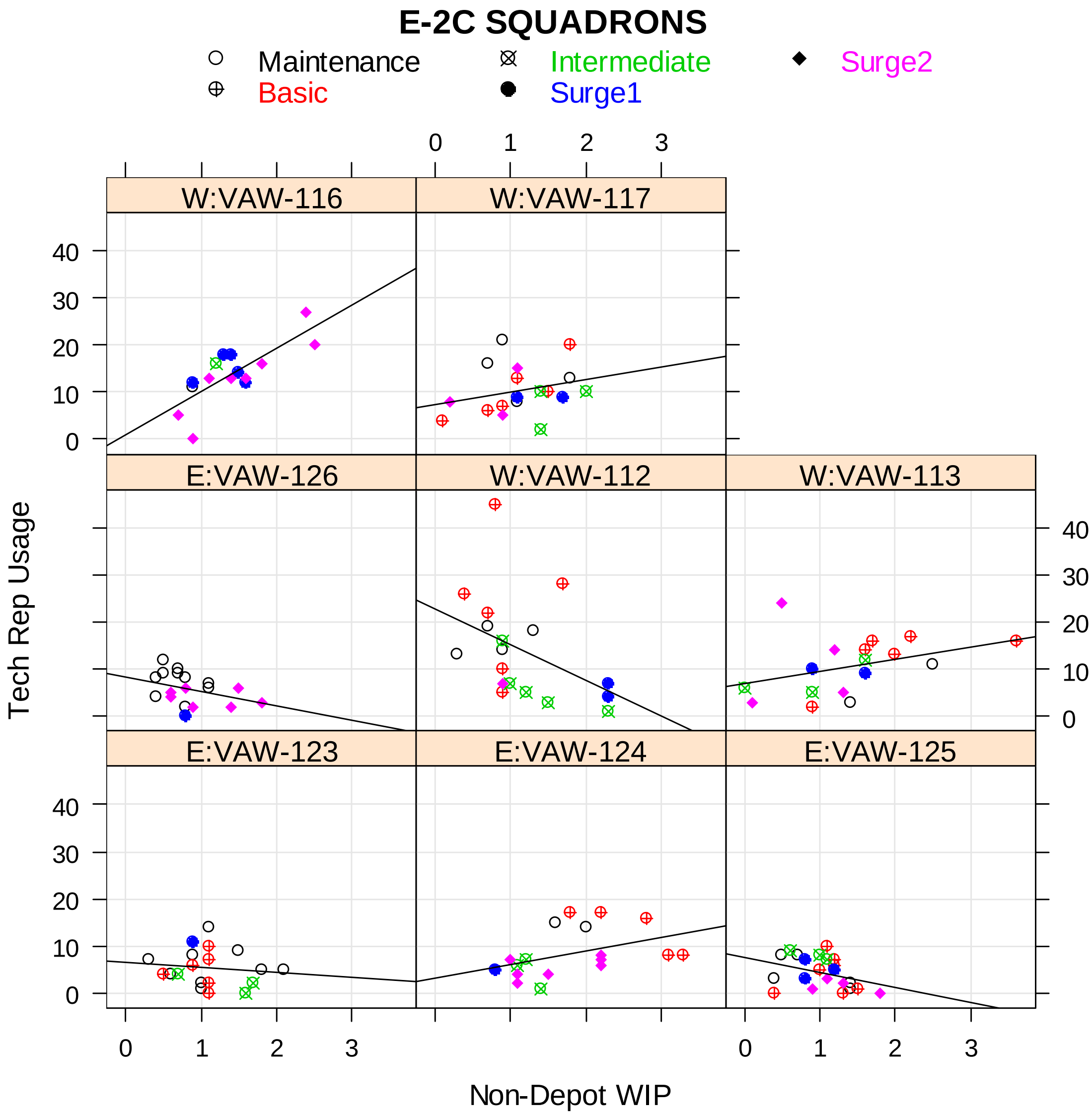

Figure 24. Tech Rep Usage compared to Non-Depot WIP per Month for each E-2C Squadron (without Deployment Phase)

H. TECH REP USAGE COMPARED TO OTHER METRICS BY COAST AND FRTP PHASE

Comparing Tech Rep usage to Other Metrics by Coast and FRTP Month indicates that there is a more complex relationship between Tech Rep usage and other metrics. Looking at the data in this way separates the data into 12 groups. Having this many groups and only two years of data that is usable, care must be given when analyzing these plots as more data will be required to prove that relationships actually do exist between Tech Rep usage and the other metrics.

The Deployment Phase for both coasts and E-2C and FA-18C/D Squadrons for almost all of the metrics indicated no slope. During deployment, Tech Rep usage is much lower which would explain why there is no relationship within the metrics for the Deployment Phase. Within E-2C Squadrons, only one or two phases within a coast indicate that a relationship exists. There are a few metrics that indicate more of a relationship NMCS/PMCS (Figure 25); Non-Depot WIP (Figure 27); and Maintenance Hours (Figure 28). FA-18C/D Squadrons indicate less of a relationship exists with usually only one phase within a coast having a relationship. The most relationships exist with the number of NMCS/PMCS requisitions within FA-18C/D Squadrons (Figure 26).

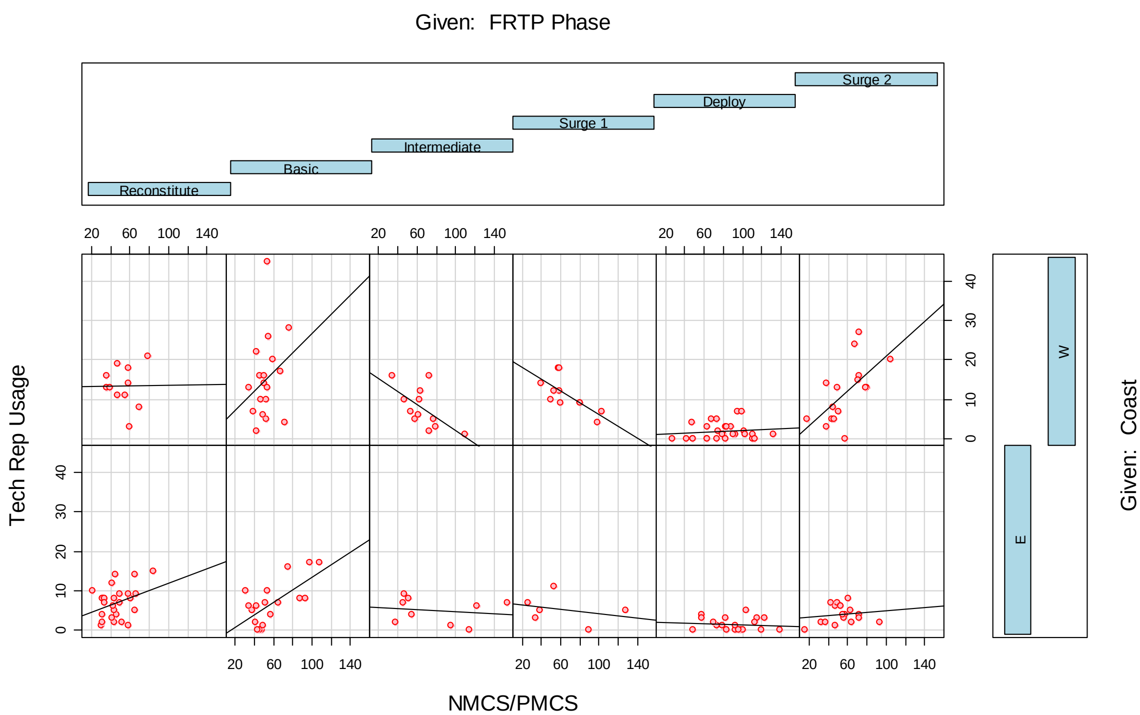

Figure 25. NMCS/PMCS compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

Comparing Tech Rep usage to the number of NMCS/PMCS requisitions per month for E-2C (Figure 25) and FA-18C/D squadrons (Figure 26) by Coast and FRTP Month indicate that there are some differing relationships. For E-2C Squadrons, the Basic Phase East Coast and Surge 2 Phase West Coast have positive slopes that indicate that an increase in NMCS/PMCS relates to an

increase in Tech Rep usage. The Intermediate Phase West Coast has a negative slope indicating that as the number of NMCS/PMCS increases, Tech Rep usage decreases. This decrease could possibly be explained by the fact that it is during the Intermediate Phase that a squadron is away from its home base and participating in COMPTUEX, and carrier air wing strike training at NAS Fallon. During these exercises, the squadrons do not have Tech Rep Services readily available. For FA-18C/D Squadrons (Figure 26), a positive slope exists for Surge 1 Phase East Coast but there are not enough observations for that relationship to be strong. Seven of the twelve groups do have a positive slope which could indicate a relationship exists but will require more in-depth analysis with regression modeling which will be discussed in Chapter IV.

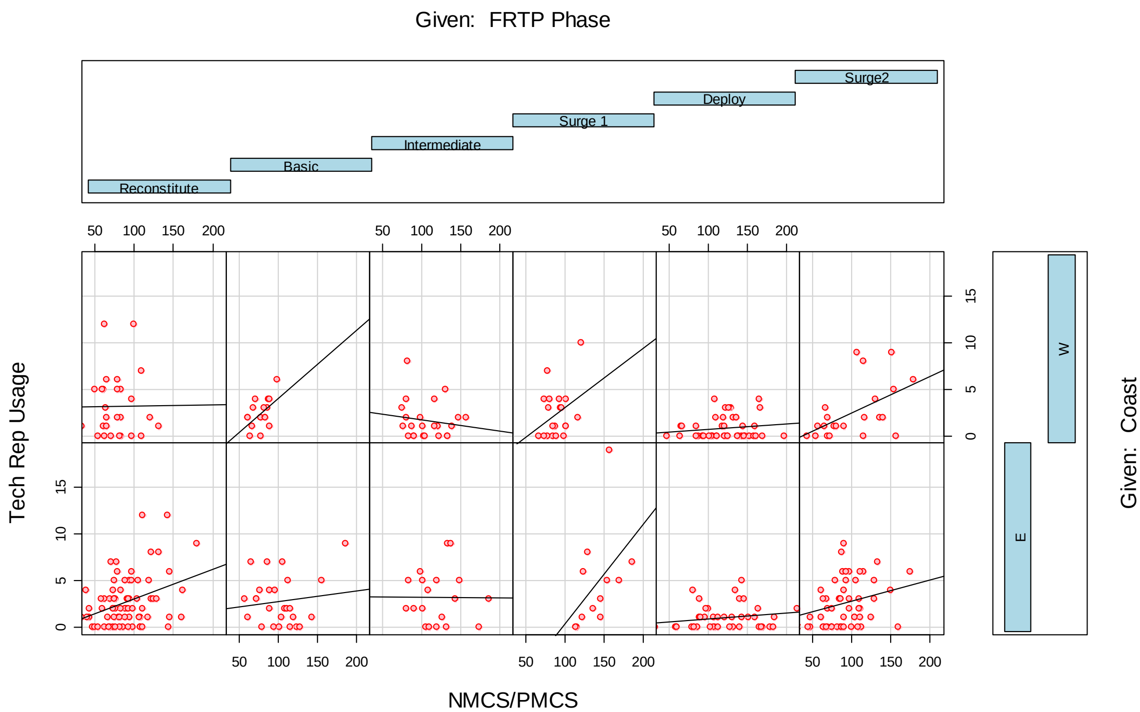

Figure 26. NMCS/PMCS compared to Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

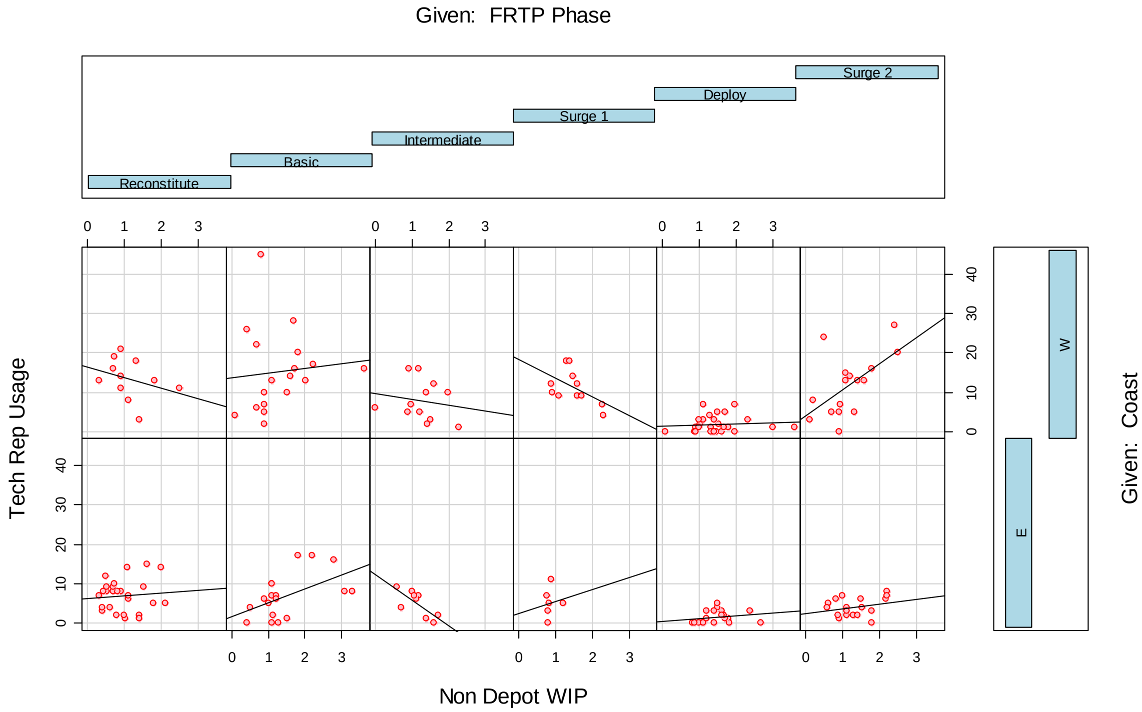

Figure 27. Non-Depot WIP compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

Non-Depot WIP compared to Tech Rep usage per month for E-2C Squadrons by Coast and FRTP Phase (Figure 27) have similar characteristics as NMCS/PMCS for E-2C Squadrons. Within Basic Phase West Coast, there is one observation with over 40 Tech Rep Assists. With this taken out, there would be a more positive relationship within that group.

Maintenance Hours compared to Tech Rep usage per Month for E2-C Squadrons by Coast and FRTP Phase (Figure 28) have seven of twelve groups with a positive slope indicating that an increase in Maintenance Hours is related to an increase in Tech Rep usage. The Reconstitute (Maintenance) Phase East Coast has higher variability compared to the other groups. There are also five groups that have many fewer observations than the other seven groups and it is difficult to say whether there really is a relationship within those groups.

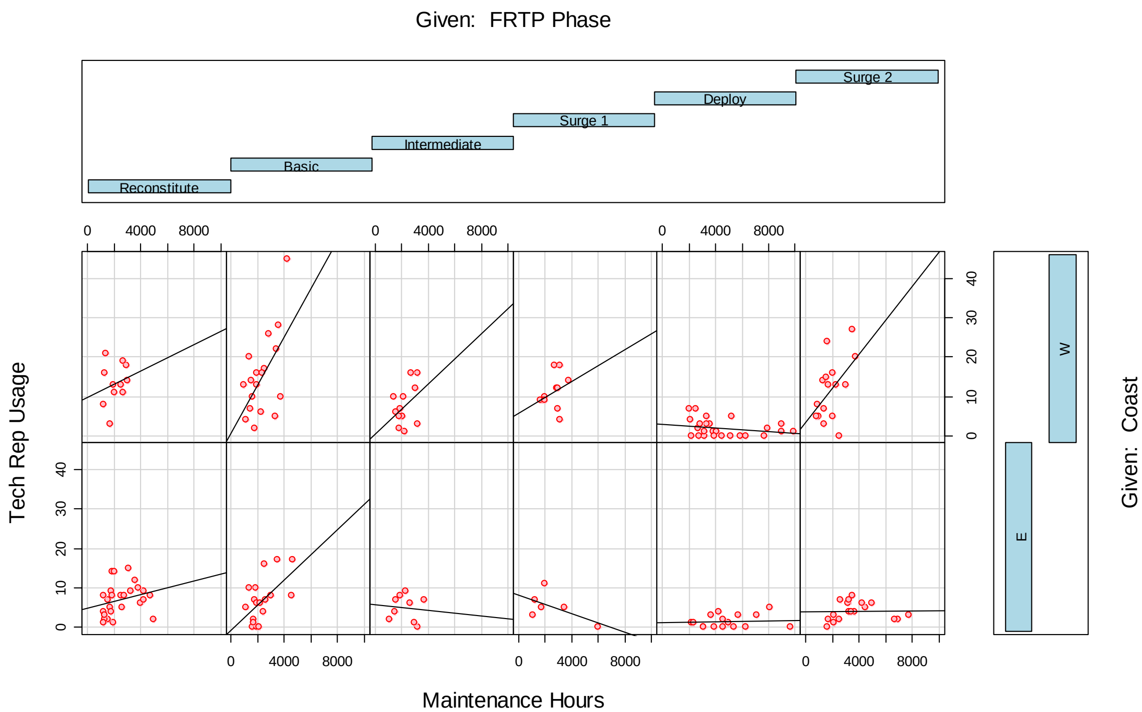

Figure 28. Maintenance Hours compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

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IV. MODELING ANALYSIS

A. OBJECTIVE

In the previous chapter we used graphical techniques to explore the relationships of Tech Rep usage to other metrics. Because these relationships are very complex, in this chapter we use regression techniques to build a model to predict Tech Rep usage as a function of the metrics explored in the previous chapter. The Deploy FRTP Phase is excluded for both E-2C and FA-18C/D squadrons because Tech Reps are not readily available in this phase. E-2C and FA-18 squadrons are modeled separately.

B. DEVELOPING THE MODEL

1. Principal Component Analysis

It is clear that the many metrics studied in the previous chapter are dependent on one another. Principal Components is fit to several subsets of variables to discover which have a high degree of multicollinearity and which are more linearly independent. For both E-2C and FA-18C/D squadrons AcftInSvc and EIShrs are highly correlated as are NMCEvents and Throughput. All have pairwise correlations greater than 0.9. The three variables NMCRate, NMCHrs, and NonDepWIP have a first Principal Component that explains 93% and 95% for E-2C and FA-18C/D squadrons respectively of the variability of these three variables and thus are also highly linearly dependent. Of the subsets of variables which did not show as a high degree of multicollinearity, the subset containing the eight variables MnPwrDNEC, NonDepWIP, AVDLR, AfmOther, RftAct, MaintHrFltHr, Cann100FltHr, and FltHrNMC had the greatest number of variables. Translation of these variables can be found in Table 13 in Appendix D. For both E-2C and FA-18 squadrons, the cumulative proportion of the variability explained by the first principal components does not exceed 90% until seven principal components are modeled. Thus although there is multicollinearity, it is not as great as in other subsets of variables. This subset of variables is used as the basis to build a predictive model for Tech Rep usage. We should note that when variables are dependent, there is no unique set of variables that are the

"best" to use for prediction. Other subsets of variables can give similar predictive models. For example, replacing NonDepWIP by NMCRate and NMCHrs yields model fits that are comparable to those fit in this chapter.

2. Poisson Regression Model

Tech Rep usage is measured by number of assists. The usual linear regression model is not appropriate for this data because the variability in the number of assists increases with the expected number of assists. This is common with count variables such as number of assists. A more appropriate approach is to use a Poisson regression model [Dobson, A. J. (1990)]. Such a model is a special case of a generalized linear model. Let Y represent number of assists. In Poisson regression, Y is modeled as a Poisson random variable with $\mathrm{E}[Y] = \mu$ where $\ln(\mu)$ is a function of values of the predictors included in the model. For such models, the variance of Y is also μ. For models fit to both E-2C's and FA-18's, the fact that the model residual deviance is much greater than the corresponding degrees of freedom indicate that no matter what predictors are used (including interactions and nonlinear terms) that the variability of Tech Rep usage (Y) is greater than can be expected from a Poisson regression model.

This overdispersion is consistent with our understanding that there are many variables affecting the level of Tech Rep usage that are not captured in the metrics used here. As for modeling, to take into account this overdispersion, a quasi-Poisson regression model is used where $\ln(\mu)$ is still a function of predictors but the variance of Y is $\phi\mu$ where ϕ is a dispersion parameter to be estimated.

3. Model Fitting

An initial quasi-Poisson regression model is fit with all eight variables and two-way interaction terms between all variables and Coast and between all variables and Rcat. A combination of stepwise selection using Akaike's Information Criterion (AIC) [Venables, W. N. and Ripley, B. D. (2002)] and backwards elimination using the likelihood ratio test based on the quasi-Poisson

regression model is used for variable selection. For both E-2C's and FA-18's, the reduced models are checked to see if a nonlinear transformation of variables is required using partial residual plots. For the FA-18C/D model, a logarithmic transformation for RFTAct is used. We note that using Cook's Distance [Williams, D. A. (1987)] several influential observations are identified. For E-2's, the influential observations are observations 13, 68, 100, and 137. For FA-18C/D there is only one influential observation which is observation 641. In both cases the influential observations are unusual enough, with values of Cook's distance greater than one, to warrant their removal.

4. The Final Model

We fit an overdispersed log-linear model where the response variable is Tech Rep usage (ElarCount is the model variable) per month per squadron and the predictors are a combination of numeric variables (Table 9) and categorical variables (Coast and Rcat). Interaction terms for the two models are identified in Table 10. Translation of the model variables can be found in Table 13 in Appendix D.

E-2 Squadrons	FA-18C/D Squadrons
MnPwrDNEC	MnPwrDNEC
RftAct	RftAct
Cann100FltHr	Cann100FltHr
NonDepWIP	AVDLR
MaintHrFltHr	AfmOther
	FltHrNmc

Table 9. Numeric Variables for the E-2C and FA-18C/D Log Linear Model

E-2 Squadrons	FA-18C/D Squadrons
NonDepWIP:Rcat	MnPwrDNEC:Coast
MaintHrFltHr:Rcat	MnPwrDNEC:Rcat
Cann100FltHr:Rcat	AfmOther:Rcat
	Rcat:RftAct
	Cann100FltHr:Coast

Table 10. Interaction Terms for the E-2C and FA-18C/D Log Linear Model

For categorical variable Coast, which takes two levels (East and West), the predictor variable is an indicator variable taking on values 0 and 1 for East and West respectively and which corresponds to the coefficients labeled CoastW in Table 11 and Table 12, both in Appendix C.

For categorical variable Rcat (FRTP Phase), which takes five levels (Basic, Intermediate, Reconstitute, Surge 1, and Surge 2), there are four indicator variables (one each for Intermediate, Reconstitute, Surge 1, and Surge 2) corresponding to the coefficients labeled RcatIntermediate, RcatReconstitute, RcatSurge 1, and RcatSurge 2 in Table 11 and Table 12, both in Appendix C. For Basic phase, all values of these four indicator variables are zero.

Cross validation [Burman, P. (1989)] is then conducted to get an estimate of the mean squared error of predicting Tech Rep usage. The data is divided randomly into 10 groups. For each group the generalized linear model is fit to data omitting that group. These fits are used to predict Tech Rep usage for observations in the group that is omitted from the fit. The mean squared error is based on the squared differences between these predicted values and the observed values. The cross-validation estimate of prediction error is then compared to the mean squared error for the model. Cross validation is conducted 100 times for each model with a mean cross-validation estimate of prediction error of 40.22 and 7.13 for the E-2C and FA-18C/D models respectively. The mean squared error for the E-2C and FA-18 model is 19.71 and 5.40 respectively. The large mean squared errors, especially for E-2C's, indicates that while there is a relationship between Tech Rep usage and the predictor variables, the model does not have great predictive ability. However, it can be used to study general trends.

C. MODEL ANALYSIS

To explore the relationship between predicted Tech Rep usage and predictors in the models, three different plots are constructed (for both E-2C and FA-18C/D models) where the predictors (Manpower Percent DNEC, RFT Actual, and Cannibalizations per 100 Flight Hours) were allowed to vary. To construct

the dataset used for these plots, the median value within each FRTP Phase and Coast (i.e. Reconstitute E, Reconstitute W, Basic E, Basic W, …) is calculated for the predictors which remain constant. Different constant values are used for each level of Phase and Coast since in the Chapter III, it was observed that Tech Rep usage is dependent upon which FRTP Phase and Coast a squadron is in. Using one value for each predictor would result in unrealistic outcomes from the model. The median within each group is used rather than the mean since there are outliers within some of the groups that influence the mean.

Predicted Tech Rep usage is estimated based on these new datasets. The predicted values are then plotted against the varied predictor along with 95 percent confidence intervals for the expected Tech Rep usage. Care must be given when interpreting the plots, as in some groups, the varied predictor only takes a smaller range of original values.

1. Manpower Percent DNEC

Manpower Percent DNEC is compared to the predicted values of Tech Rep usage by Coast and FRTP Phase for E-2C squadrons (Figure 29) and FA-18C/D squadrons (Figure 30). To compare these plots, Manpower Percent DNEC is compared to Tech Rep usage by Coast and FRTP Phase for E-2C Squadrons (Figure 60 in Appendix C) and FA-18C/D Squadrons (Figure 61 in Appendix C) with the original dataset.

For E-2C squadrons, in the predicted model, there appears to be a positive relationship in each group where an increase in Manpower Percent DNEC is related to an increase in Tech Rep usage. The West Coast squadrons have wider confidence intervals which indicate that the relationship could be closer to that of East Coast squadrons.

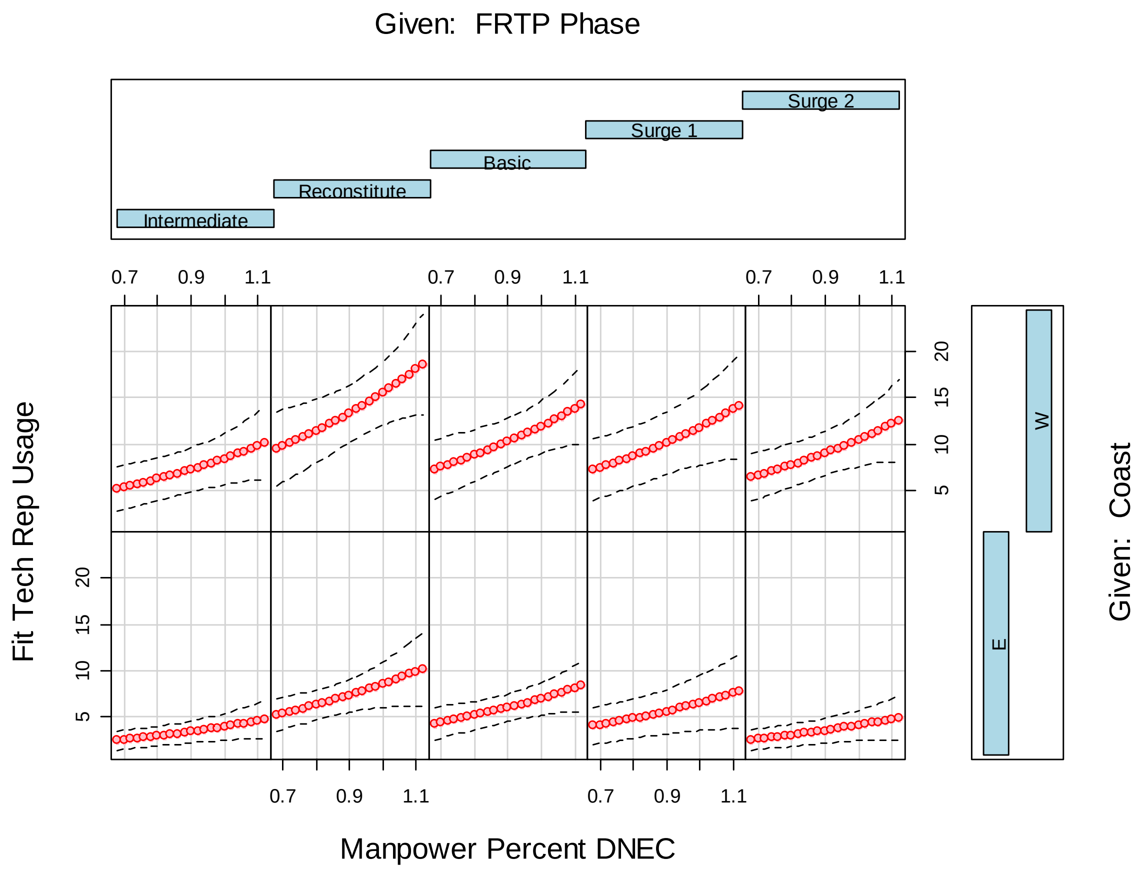

Figure 29. Sequenced Manpower Percent DNEC compared to Fitted Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

FA-18C/D squadrons, in the predicted model, have a much different relationship than E-2C squadrons. There is very little slope for West Coast squadrons, indicating that Tech Rep usage is not as strongly related to Manpower Percent DNEC. East Coast squadrons have a fairly tight confidence interval for Manpower Percent DNEC between 0.7 and 0.9 which indicates a good fit within this range. There are only a few data points above 0.9 for Manpower Percent DNEC for East Coast squadrons which explains why the confidence intervals spread out. Between the values of 0.7 and 0.9 for Manpower Percent DNEC, East Coast squadrons, there is a positive relationship in all but Intermediate Phase, indicating that an increase in Manpower Percent DNEC is related to in an increase in Tech Rep usage. In the Intermediate

Phase, for East Coast squadrons, there is very little or no slope which indicates there is no relationship between Manpower Percent DNEC and Tech Rep usage during this phase.

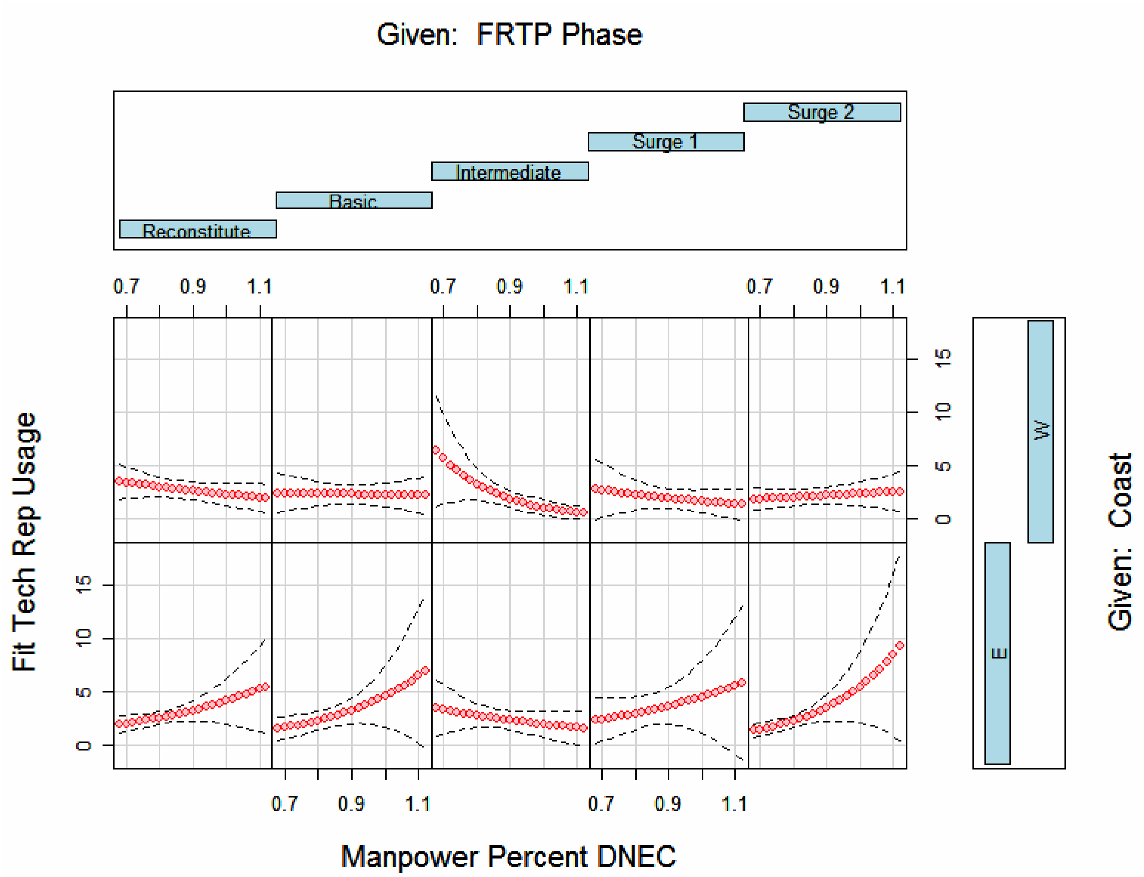

Figure 30. Sequenced Manpower Percent DNEC compared to Fitted Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

2. RFT Actual

RFT Actual is compared to the predicted values of Tech Rep usage by Coast and FRTP Phase for E-2C Squadrons (Figure 31) and FA-18C/D Squadrons (Figure 32). To compare these plots, RFT Actual is compared to Tech Rep usage by Coast and FRTP Phase for E-2C squadrons (Figure 62 in Appendix C) and FA-18C/D squadrons (Figure 63 in Appendix C) with the original dataset. There is a RFT Entitlement that is part of the FRTP and its value is dependent upon which month of the FRTP that a squadron is in. The entitlement is highest in the Deployment Phase and lowest in the Reconstitute Phase.

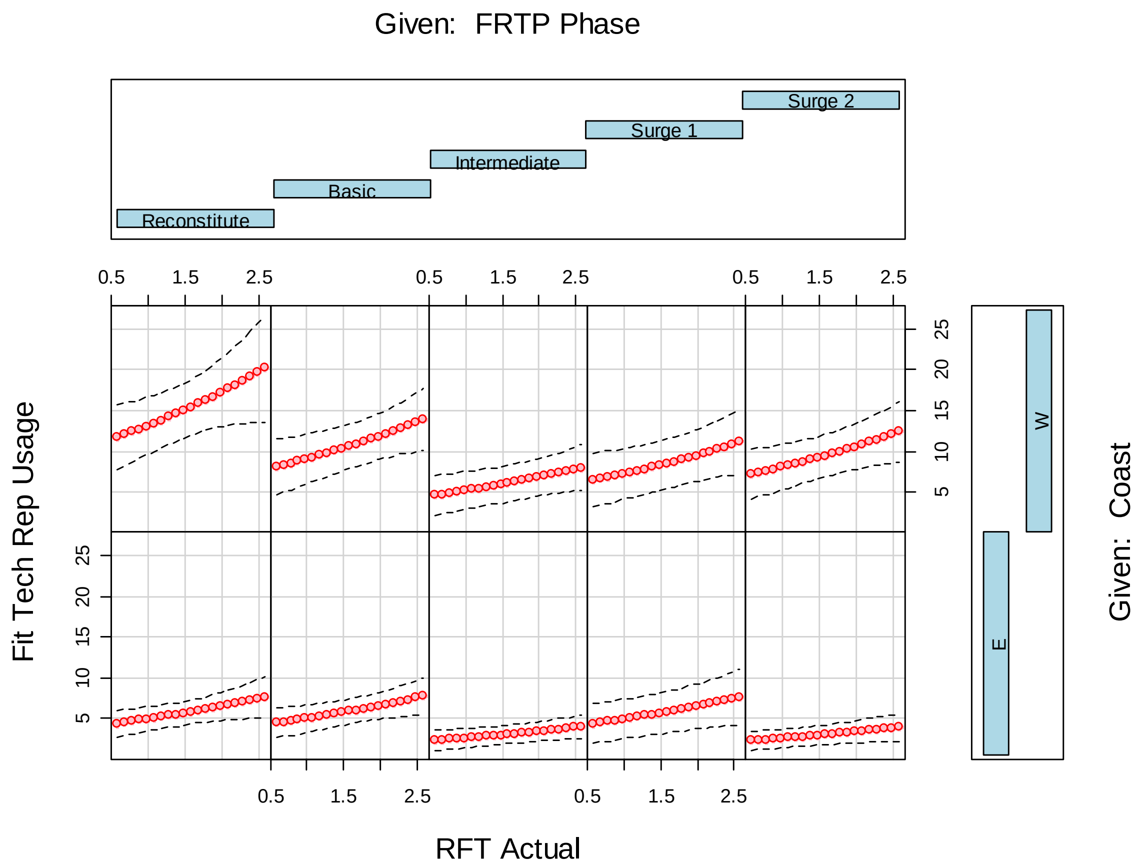

Figure 31. Sequenced RFT Actual compared to Fitted Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

For both East and West Coast E-2C Squadrons, in the predicted model, there is a positive slope in each group, indicating that an increase in RFT is related to an increase in Tech Rep usage. As seen for West Coast squadrons for Manpower Percent DNEC, there are wide confidence intervals for West Coast squadrons with RFT Actual indicating that the relationship might be closer to that of East Coast squadrons.

For RFT Actual, FA-18C/D Squadrons in the predicted model, have a much different relationship than E-2C Squadrons. During the Reconstitute, Basic, and Intermediate Phases, there appears to be a slight negative relationship indicating that an increase in RFT Actual might be related to less Tech Rep usage. Only in Surge 1 Phase is there evidence indicating that an increase in RFT Actual might be associated with an increase in Tech Rep usage.

It is also during this phase that squadrons are getting their aircraft ready for deployment, and the aircraft are at their best condition possible prior to deploying. For squadrons in Surge 2 Phase, there does not appear to be any relationship between RFT Actual and Tech Rep usage.

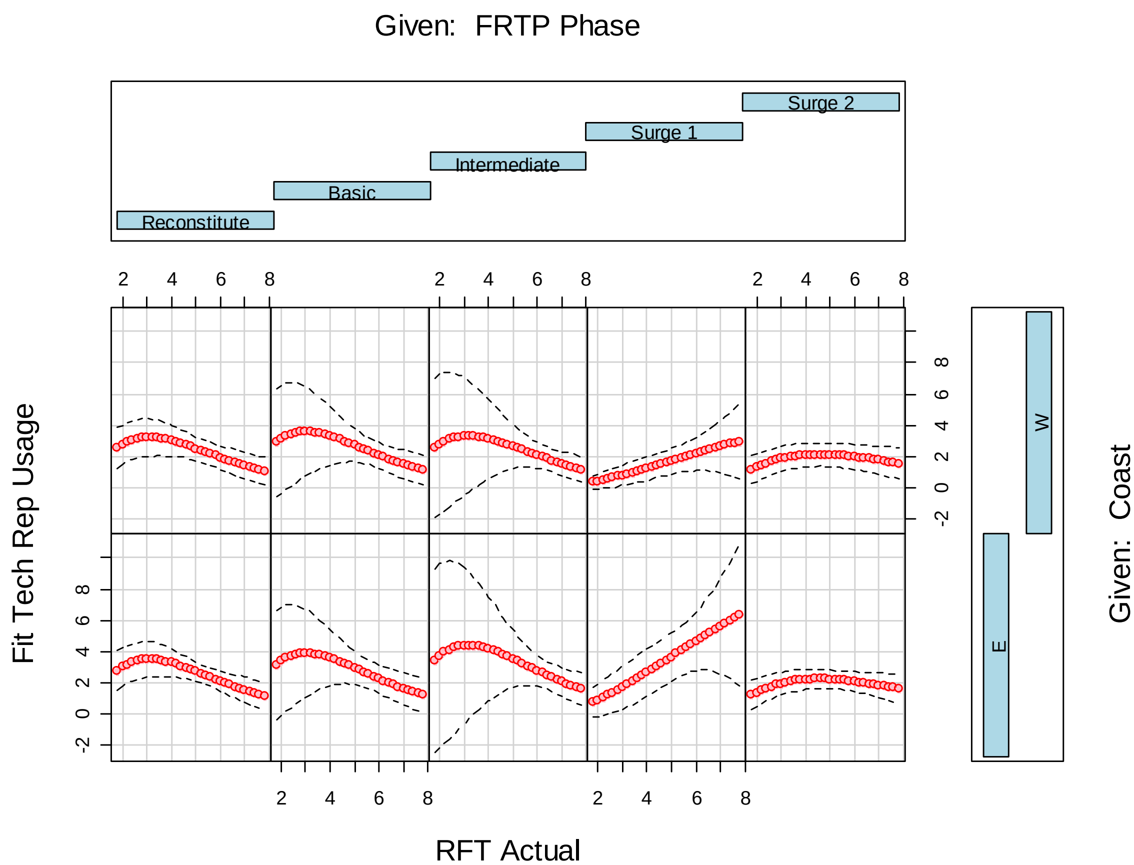

Figure 32. Sequenced RFT Actual compared to Fitted Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

3. Cannibalizations per 100 Flight Hours

Cannibalizations per 100 Flight Hours is compared to the predicted values of Tech Rep usage by Coast and FRTP Phase for E-2C Squadrons (Figure 33) and FA-18C/D Squadrons (Figure 34). To compare these plots, Cannibalizations per 100 Flight Hours are plotted against Tech Rep usage by Coast and FRTP Phase for E-2C Squadrons (Figure 64 in Appendix C) and FA-18C/D Squadrons (Figure 65 in Appendix C) with the original dataset.

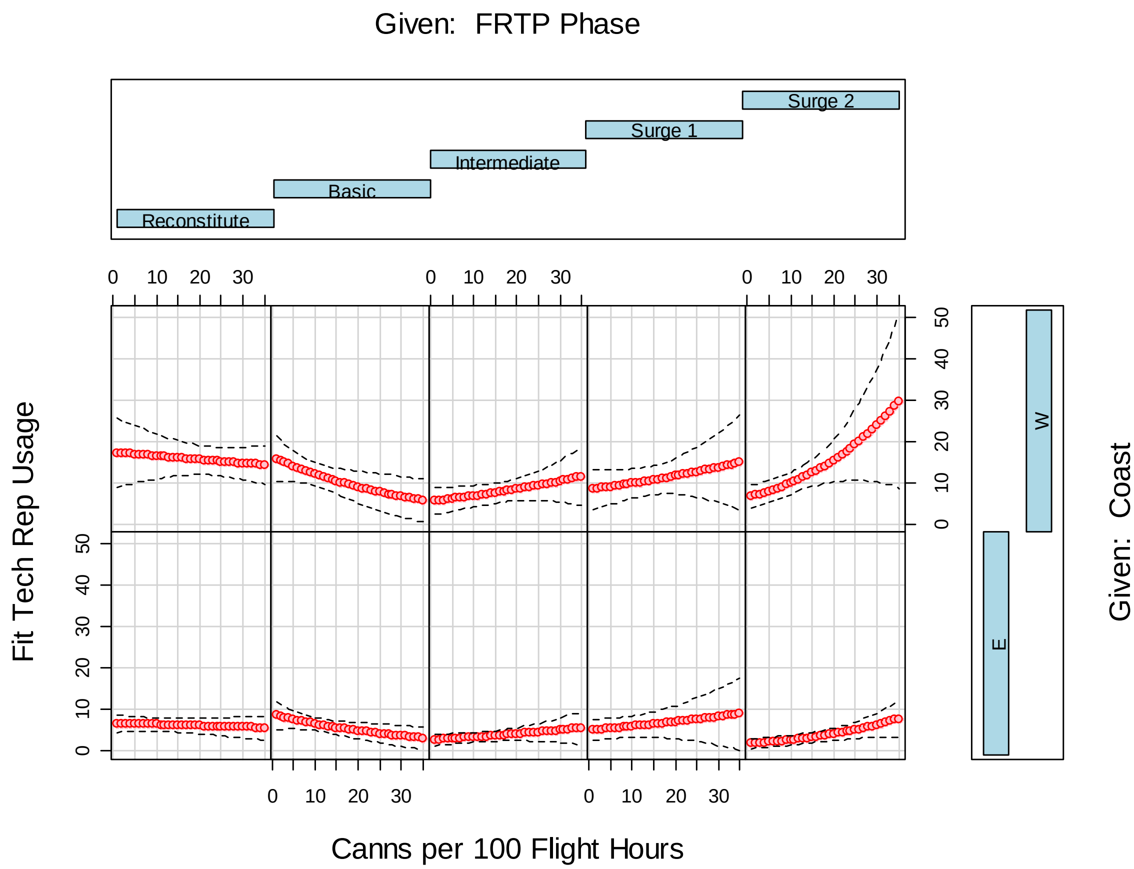

Figure 33. Sequenced Cannibalizations per 100 Flight Hours compared to Fitted Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

For E-2C Squadrons, in the predicted model, where the confidence intervals are narrow, with the exception of Basic Phase West Coast, during Reconstitute, Basic, Intermediate, and Surge 1 Phases, there is very little slope. This indicates that there is no relationship between Cannibalizations per 100 Flight Hours and Tech Rep usage. During the Basic Phase for West Coast squadrons, there is evidence of a negative relationship indicating that an increase Tech Rep usage is related to a decrease in Cannibalizations per 100 Flight Hours. Most of the original data points fall between 5 and 20 Cannibalizations per 100 Flight Hours which on the predicted plot equates to a decrease in five assists. Surge 2 Phase, for both East and West Coast, indicates a positive relationship (more so for West Coast) between Cannibalizations per

100 Flight Hours and Tech Rep usage, indicating that an increase in Cannibalizations per 100 Flight Hours is related to an increase in Tech Rep usage.

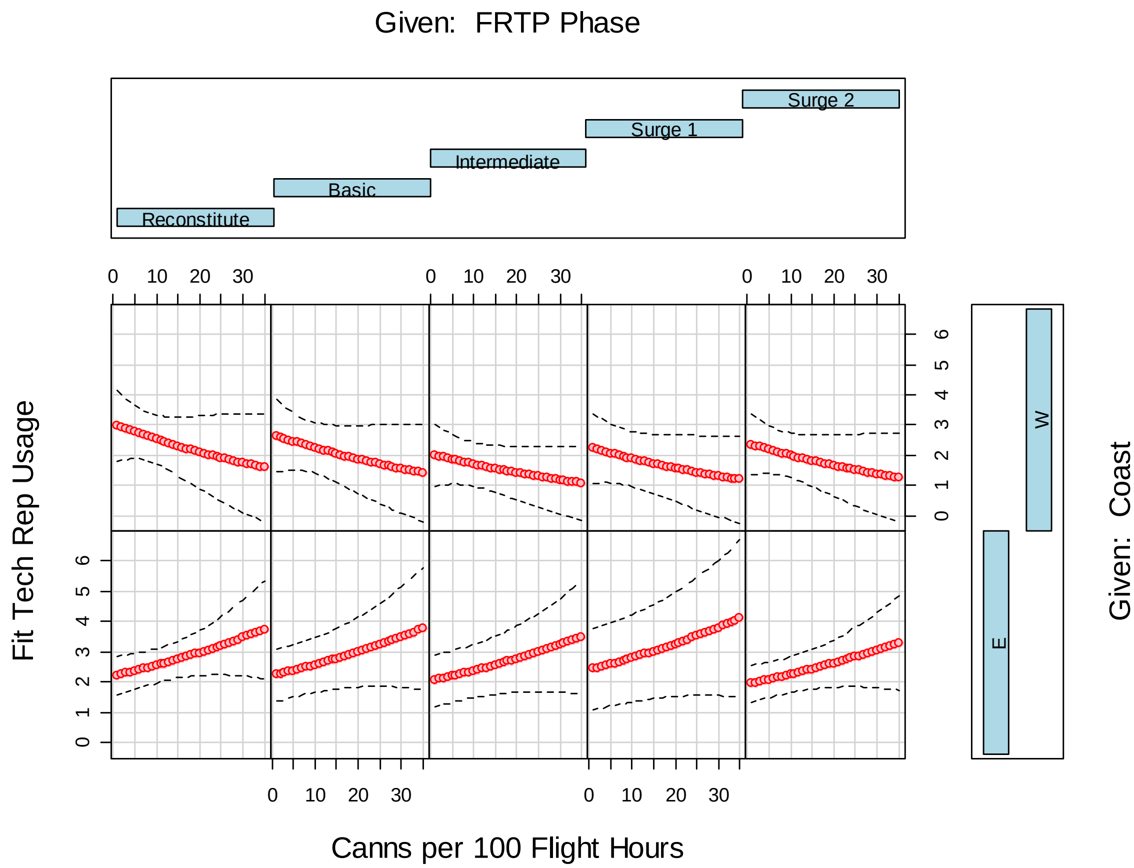

Figure 34. Sequenced Cannibalizations per 100 Flight Hours compared to Fitted Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

For FA-18C/D Squadrons, the West Coast has a negative slope, indicating that an increase in Tech Rep usage is related to a decrease in Cannibalizations per 100 Flight Hours. In contrast, East Coast has a positive slope, indicating that an increase in Cannibalizations per 100 Flight Hours is related to an increase in Tech Rep usage. In both cases the confidence intervals are wide enough that these trends might be artifacts of the data. On the other hand, it is possible that East Coast might take a more proactive approach towards Tech Reps services

than West Coast. The confidence intervals for both coasts have wide intervals except for East Coast squadrons in Reconstitute or Surge 2 Phase where the confidence interval's width is only about one assist until the confidence intervals begin to fan out. This indicates that the model is only predicting well for East Coast squadrons in Reconstitute and Surge 2 Phases between zero and twenty Cannibalizations per 100 Flight Hours. Looking at the original data for East Coast during these phases, most of the data falls into the range between zero and twenty.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

In this thesis, monthly data is examined from eleven E-2C squadrons and thirty-seven FA-18 squadrons taken over a two-year period, from FY-05 and FY-06. Research began by identifying databases that contained squadron performance metrics and that are easily accessible. Six databases, or data sources, were identified: Aviation Financial Analysis Tool (AFAST) contains detailed financial data for each squadron along with parts usage and MAF entries. The month and phase of the Fleet Readiness and Training Plan (FRTP) that a squadron is in is a very important metric that is obtained from CNAF and used extensively with this research. Readiness, Standards, and Policy (RS&P) metrics along with Maintenance & Supply Chain Management (M&SCM) metrics are obtained through the Electronic Readiness Integrated Improvement Program (eRIIP) database that is available online. To validate some of the data within eRIIP and also to complete missing data, Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) data is used. Maintainer manpower data is obtained from the Enlisted Distribution and Verification Report (EDVR) database from Millington, TN. Lastly, the ELAR database is used to collect data on Tech Rep usage by the number and hours of assists per month per squadron. Efforts are underway to replace ELAR by a new CRM system.

Numerous plots of Tech Rep usage compared to other performance metrics by FRTP Phase and Coast were constructed. These plots clearly indicate that which coast and FRTP Phase that a squadron is in has an affect on Tech Rep usage. Within E-2C squadrons, West Coast Tech Rep usage is greater per month than on the East Coast. Within FA-18C/D squadrons, West Coast Tech Rep usage is less per month than East Coast Squadrons'. Some plots that might explain some of the differences in usage are Tech Rep usage compared to Maintainers COB and Manpower Percent DNEC by Coast. For E-2C squadrons, East Coast squadrons have higher manning levels than West Coast squadrons. However, with respect to Manpower Percent DNEC, West

Coast squadrons have more of their required DNEC billets filled. Having lower manning levels on the West Coast could be a factor associated with higher Tech Rep usage for E-2C squadrons. There are other factors, such as accessibility to Center for Naval Aviation Technical Training (CNATT) schoolhouses not captured by metrics in this analysis that can help explain the differences in East and West Coast Tech Rep usage.

Manning levels for East and West Coast FA-18 squadrons are similar. West Coast squadrons do show higher Manpower Percent DNEC than do East Coast squadrons. It is unclear why East Coast shows higher Tech Rep usage since with E-2C squadrons, higher Manpower Percent DNEC and higher Tech Rep usage (for the West Coast) seems to correspond with higher Tech Rep usage. The differences between Coasts and FRTP Phases can not be completely explained by comparing Tech Rep usage to other squadron performance metrics.

By plotting each metric against the FRTP months by Coast, trends are identified for some metrics throughout the FRTP cycle. There are several metrics that show similar trends. For these trends, presumably RFT is the driving force since there is a RFT Entitlement based upon which month of the FRTP cycle a squadron is in. Few relationships between Tech Rep usage and other metrics were identified by Coast and FRTP Phase. Where weak relationships seem to exist, there are not enough observations, with only two years of data, to say that there actually is a relationship.

The overdispersed Poisson Regression model developed for E-2C and FA-18C/D squadrons indicates mostly positive relationships between Tech Rep usage and the other variables for each Coast and FRTP Phase. Some examples of this are that higher Manpower DNEC could indicate that there are more specialized maintainers that need to be trained and a high Cannibalization per 100 Flight Hours rate could indicate that a squadron is having problems with maintenance and require more Tech Rep Services. With the low quality of the Tech Rep usage data and the fact that only two years of data (in a 27-month

FRTP cycle) are used make drawing specific conclusions from such an analysis questionable. However, some general trends observed in this analysis seem plausible.

With a small dataset, containing only two years worth of data and the fact that there are intangible effects on Tech Rep usage, the models developed for predicting Tech Rep usage do not predict Tech Rep usage very precisely. More analysis will need to be conducted when the databases are more populated to identify relationships between Tech Rep usage and other squadron metrics as well as to be able to develop a model that better predicts Tech Rep usage. There are so many factors with aviation maintenance that are in continuous change, depending upon the circumstances at hand, that such models, even with more data, may only be useful for projecting general trends.

B. RECOMMENDATIONS

1. NATEC

a. Strategic Plan (goal #4)

(1) Efficiently collect valid data to support models. It has been demonstrated that data can be efficiently collected with the databases identified in this thesis and should be used to collect valid data to support models that will be developed in the future. Additional manpower metrics that are within the EDVR database that might be needed to support these models should be easy to incorporate into eRIIP as EPMAC already runs a query for manpower data from the EDVR database that is then uploaded into the eRIIP database. Most of the data collection needed to develop models is already taking place and thus will not have a negative impact on customers. The number of additional metrics that are not already being captured by one of the databases should be minimal.

(2) Establish, communicate and utilize Fleet metrics acceptable to all stakeholders. As previously mentioned, most of the metrics, measures of effectiveness, and measures of performance are already being captured in databases utilized by the Fleet and are acceptable to all

stakeholders. Emphasis should be placed on working with the organizations that are the owners of these databases to develop a monthly validation process to ensure that the data within these databases is accurate and complete.

(3) Utilize models to forecast demand for and impact of Technical Services. Some key drivers for the requirement of Technical Services were identified within this thesis. As the databases used in the collection of data are relatively new, time must be given to populate these databases with more data to be able to develop a useful predictive model to forecast the requirement for and impact of Technical Services. Additional metrics that were not included in this thesis should also be researched and analyzed to assist in developing useful predictive models.

b. ELAR

ELAR will be replaced by a CRM system which will address several of these specific difficulties encountered when using ELAR.

(1) Monthly Hours. The numbers of hours per assist that cover more than one month are not separated by the hours within each month. Future versions of ELAR should have the ability to capture the number of hours that are actually used when they are used for an assist.

(2) Squadron Field. The Squadron Field should have a drop-down menu rather than being manual entry. This will prevent a particular squadron from being entered in numerous ways (e.g. “VAW-112,” “VAW 112,” and “VAW112”).

(3) Separate Entry for Each Squadron. When “ALL” is submitted in the Squadron field, it can not be determined which squadrons actually included in the ELAR assist. A separate ELAR entry should be automatically initiated for each squadron that is actually assisted.

When training (e.g. classroom training) is conducted with more than one squadron a separate ELAR should be automatically initiated for each squadron present so that the effect of that training can be analyzed by squadron.

(4) Morning Rounds. When morning rounds are conducted and no training or technical advice is given, "Morning Rounds" should be entered in the Problem Type field so that it can be accounted for in any analysis.

(5) Include ELAR/CRM Data within eRIIP. To give NATEC services better visibility and to make analysis easier, it is worth investigating the possibility of including ELAR metrics, such as number of assists per month and number of hours of assists per month, in the eRIIP database. This will better facilitate analysis as most of the metrics used in this analysis were extracted from the eRIIP database.

2. eRIIP

The following recommendations for modification of the eRIIP database will facilitate NATEC's ability to use eRIIP data.

a. Date Range

Within the date dropdown menu, there should be an option to be able to select a beginning month/year and an ending month year. This will make it easier to analyze data within a certain date range not have to use on of the predefined parameters.

b. Type Wings

There should be an option in the Type Wing drop down menu to be able to select all of the Type Wings of one type such as Strike Fighter Wing which would combine Strike Fighter Wing Atlantic and Pacific together.

c. Validation of Data

With disparities between eRIIP and NAVRIIP as well as some numbers not fitting the data, different results from analysis could result depending on what database is used. More emphasis should be put on eRIIP to validate all of the data and have some type of certification of data each month. There is an enormous amount of analysis possible but incomplete or incorrect data greatly increases the amount of time needed to complete the analysis.

C. OPPORTUNITIES FOR FURTHER STUDY

1. Manpower Analysis

Manning levels of maintainers and their level of proficiency are important drivers of Tech Rep usage. There are a several things that could use further analysis such as: turnover within the squadrons; detailed analysis with the ranks within the rates that are currently onboard; how long a maintainer has been with the squadron; and what schools or additional training, aside from NATEC, are available at each location.

2. AFAST Type Wing Tools

Further analysis of the data within AFAST Type Wing Tools could be beneficial. There is detailed MAF data within the database that could be further analyzed to identify effects, trends, or relationships that might exist with Tech Rep usage.

3. eRIIP Analysis

As eRIIP is a relatively new database, and as it is populated with more data, further analysis should be conducted with additional metrics where the data was not available for this thesis.

4. ELAR/CRM Analysis

This thesis only scratched the surface of trends in Tech Rep usage. As CRM becomes established, more detailed analysis will be needed.

APPENDIX A. AFAST SCREENSHOTS

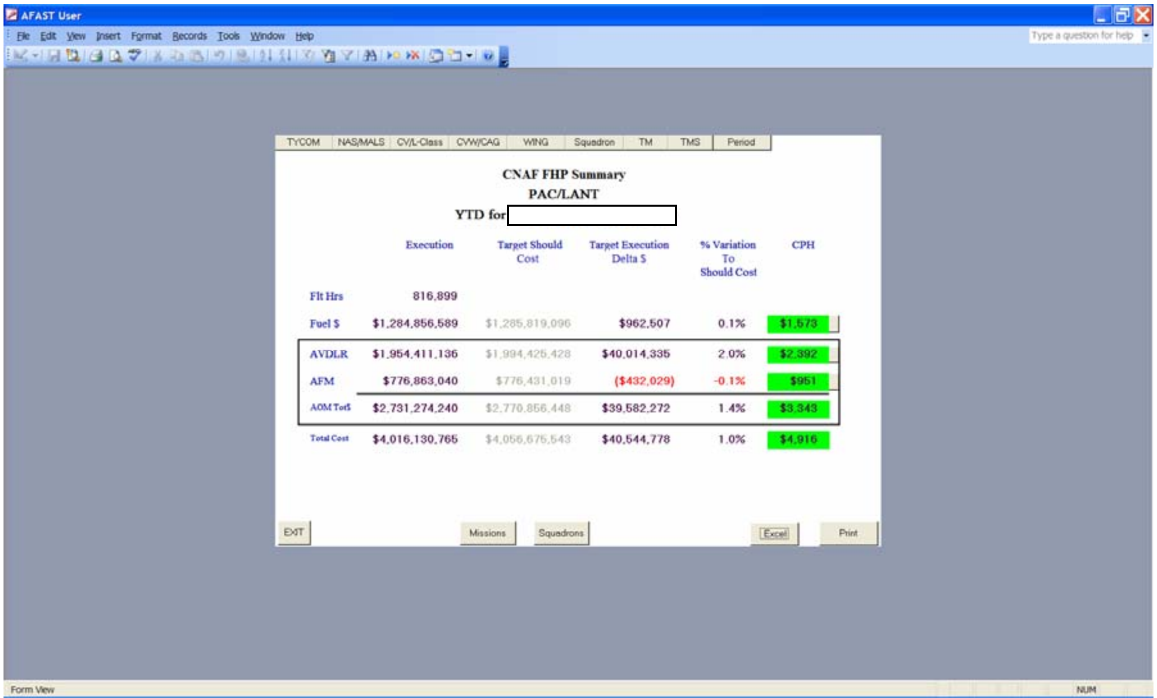

Figure 35. AFAST User Screenshot – macro level

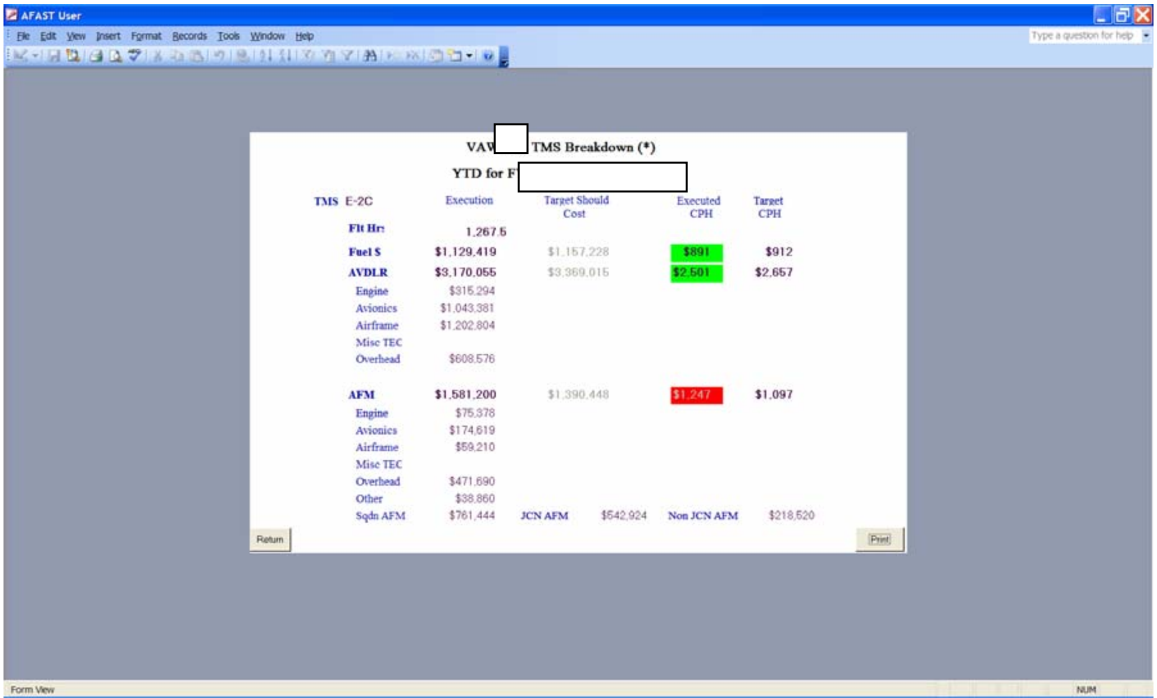

Figure 36. AFAST User Screenshot – micro level

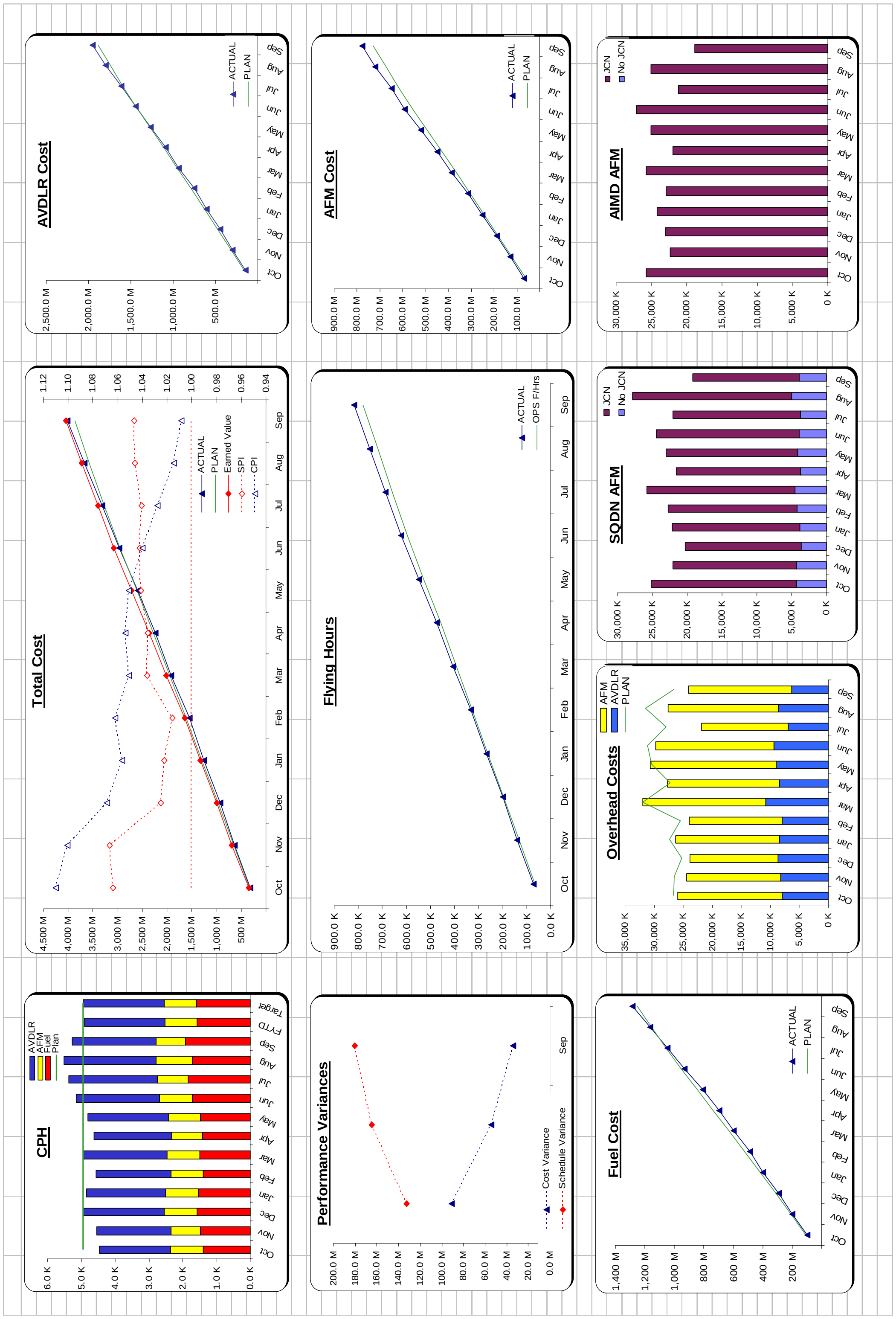

Figure 37. AFAST Cockpit Chart, EXCEL Graphs

	Actual Cost Per Hour (CPH)				Total Cost				AVDLR						
	Fuel	AVDLR	AFM	Total	Monthly	Cumulative	Plan	Monthly	Cumulative	Plan		E-V	CPI	SPI	S-V
Oct	1,385.3	2,094.9	985.9	4,466.1	311,736,743	311,736,743	325,374,865.56	146,226,859	146,226,859	158,894,206.73		346,096,117.84	1.11	1.06	20721252.28
Nov	1,473.0	2,200.6	870.0	4,543.6	317,176,857	628,913,600	649,190,342.25	153,617,609	299,844,468	317,026,898.41		692,228,927.76	1.10	1.07	43038585.51
Dec	1,573.1	2,412.0	971.0	4,956.1	298,813,671	927,727,272	967,094,674.31	145,423,997	445,268,465	472,272,930.01		991,177,698.45	1.07	1.02	24083024.14
Jan	1,539.5	2,346.3	958.8	4,844.6	324,285,935	1,252,013,207	1,294,007,533.23	157,055,084	602,323,549	631,918,203.47		1,323,080,920.75	1.06	1.02	29073387.52
Feb	1,392.8	2,223.6	954.4	4,570.9	295,555,418	1,547,568,625	1,618,258,133.39	143,781,422	746,104,971	790,263,384.20		1,643,691,905.67	1.06	1.02	25433772.28
Mar	1,488.8	2,483.6	970.3	4,942.7	369,680,308	1,917,248,933	1,944,814,009.50	185,759,812	931,864,782	949,734,327.97		2,014,547,248.13	1.05	1.04	69733238.64
Apr	1,404.2	2,303.0	917.7	4,624.9	316,203,755	2,233,452,688	2,273,366,810.98	157,458,956	1,089,323,739	1,110,180,454.23		2,353,553,859.95	1.05	1.04	80187048.97
May	1,484.1	2,372.9	942.9	4,799.9	355,572,693	2,589,025,381	2,613,532,657.74	175,779,810	1,265,103,548	1,276,297,718.04		2,720,866,928.60	1.05	1.04	107334270.9
Jun	1,709.3	2,461.0	980.8	5,151.1	376,706,120	2,965,731,501	2,958,818,934.73	179,976,179	1,445,079,727	1,444,915,502.89		3,083,481,426.89	1.04	1.04	124662492.2
Jul	1,842.7	2,623.4	910.8	5,376.9	343,043,153	3,308,774,653	3,267,346,749.39	167,370,452	1,612,450,179	1,595,582,587.39		3,399,821,254.66	1.03	1.04	132474505.3
Aug	1,715.3	2,719.3	1,072.4	5,507.0	369,758,400	3,678,533,054	3,568,264,501.46	182,585,890	1,795,036,069	1,742,533,358.85		3,732,743,921.94	1.01	1.05	164479420.5
Sep	1,909.1	2,486.9	871.9	5,267.9	337,597,676	4,016,130,730	3,870,312,171.44	159,375,025	1,954,411,093	1,890,035,916.66		4,050,505,320.13	1.01	1.05	180,193,149
FYTD	1,572.8	2,392.5	951.0	4,916.3											
Target	1,603.6	2,421.4	933.4	4,958.4											

	Flight Hours				AFM			Fuel			Overhead			
	Monthly	Cumulative	Plan		Monthly	Cumulative	Plan	Monthly	Cumulative	Plan	AVDLR Ovh	AFM Ovh	Monthly	Cumulative
Oct	69,800	69,800	65,621	65,621.1	68,815,420	68,815,420	61,252,676.93	96,694,464	96,694,464	105,227,981.90	7,963,120	18,013,246	25976366	25976366.27
Nov	69,808	139,608	130,928	65,306.6	60,730,172	129,545,592	122,211,794.79	102,829,076	199,523,540	209,951,649.05	8,249,872	16,233,459	24483332	50459697.94
Dec	60,292	199,899	195,042	64,114.4	58,544,761	188,090,353	182,058,124.08	94,844,914	294,368,454	312,763,620.22	8,678,600	15,159,962	23838563	74298260.71
Jan	66,938	266,837	260,973	65,931.3	64,183,164	252,273,517	243,600,332.31	103,047,688	397,416,142	418,488,997.45	8,402,822	17,852,546	26255368	100553628.6
Feb	64,660	331,497	326,368	65,394.3	61,714,138	313,987,655	304,641,363.31	90,059,858	487,476,000	523,353,385.87	7,965,749	16,032,880	23998629	124552257.8
Mar	74,794	406,291	392,227	65,859.3	72,569,312	386,556,967	366,116,368.60	111,351,184	598,827,184	628,963,312.93	10,852,882	21,076,846	31929729	156481986.4
Apr	68,370	474,661	458,489	66,262.0	62,741,905	449,298,872	427,967,300.35	96,002,894	694,830,078	735,219,056.41	8,470,155	19,280,359	27750514	184232500.3
May	74,079	548,740	527,093	68,604.1	69,851,225	519,150,097	492,004,418.51	109,941,657	804,771,735	845,230,521.19	8,877,809	21,797,882	30675692	214908192.2
Jun	73,132	621,872	596,730	69,636.8	71,723,883	590,873,980	557,005,471.18	125,006,058	929,777,793	956,897,960.66	9,388,644	20,308,128	29696772	244604964.7
Jul	63,799	685,670	658,953	62,223.4	58,109,242	648,983,223	615,086,646.33	117,563,459	1,047,341,252	1,056,677,515.67	6,982,658	14,829,832	21812489	266417453.8
Aug	67,143	752,814	719,642	60,688.6	72,003,001	720,986,223	671,735,207.11	115,169,510	1,162,510,762	1,153,995,935.50	8,543,749	19,011,128	27554877	293972330.5
Sep	64,086	816,899	780,558	60,916.5	55,876,825	776,863,048	728,596,477.93	122,345,827	1,284,856,589	1,251,679,776.85	6,331,322	17,767,106	24098428	318070758.6
									1,284,856,589					

	AFM Overhead		Squadron AFM		AIMD AFM			AIMD		SQUADRON	
	Monthly	Cumulative	Monthly	Cumulative	Monthly	Cumulative	PERCENT	No JCN	JCN	No JCN	JCN
Oct	18,013,246	18,013,246	25,062,060	25,062,060	25,740,114	25,740,114			25,740,114	4,351,482	20,710,578
Nov	16,233,459	34,246,706	22,102,429	47,164,489	22,394,283	48,134,397			22,394,283	4,299,176	17,803,253
Dec	15,159,962	49,406,668	20,326,000	67,490,489	23,058,799	71,193,196			23,058,799	3,608,812	16,717,187
Jan	17,852,546	67,259,214	22,158,462	89,648,951	24,172,156	95,365,351			24,172,156	3,827,319	18,331,142
Feb	16,032,880	83,292,095	22,701,355	112,350,305	22,979,903	118,345,255			22,979,903	4,216,506	18,484,849
Mar	21,076,846	104,368,941	25,739,901	138,090,207	25,752,565	144,097,819			25,752,565	4,478,759	21,261,143
Apr	19,280,359	123,649,300	21,539,385	159,629,591	21,922,161	166,019,981			21,922,161	3,728,978	17,810,407
May	21,797,882	145,447,182	23,007,978	182,637,570	25,045,365	191,065,345			25,045,365	4,092,159	18,915,819
Jun	20,308,128	165,755,311	24,365,530	207,003,100	27,050,225	218,115,570			27,050,225	3,921,186	20,444,344
Jul	14,829,832	180,585,142	22,092,470	229,095,569	21,186,941	239,302,511			21,186,941	3,762,319	18,330,151
Aug	19,011,128	199,596,270	27,890,031	256,985,601	25,101,842	264,404,353			25,101,842	5,005,702	22,884,329
Sep	17,767,106	217,363,376	19,234,526	276,220,127	18,875,193	283,279,545			18,875,193	3,955,517	15,279,009
FYTD									283,279,545	49,247,915	226,972,212

Figure 38. AFAST Cockpit Chart EXCEL Data

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APPENDIX B. ADDITIONAL EXPLORATORY ANALYSIS PLOTS

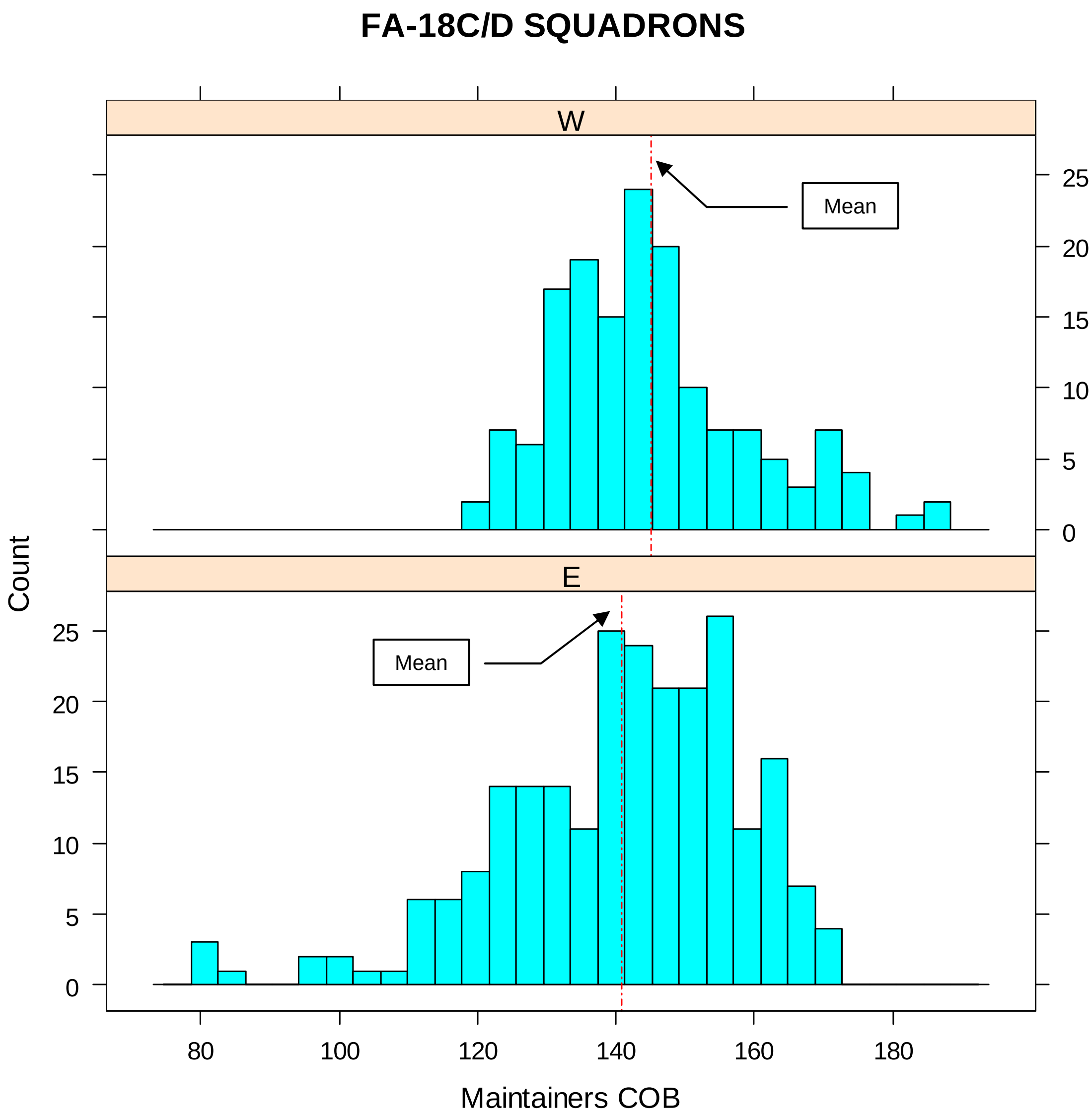

Figure 39. Histogram, Number of Maintainers per Month for FA-18C/D Squadrons by Coast

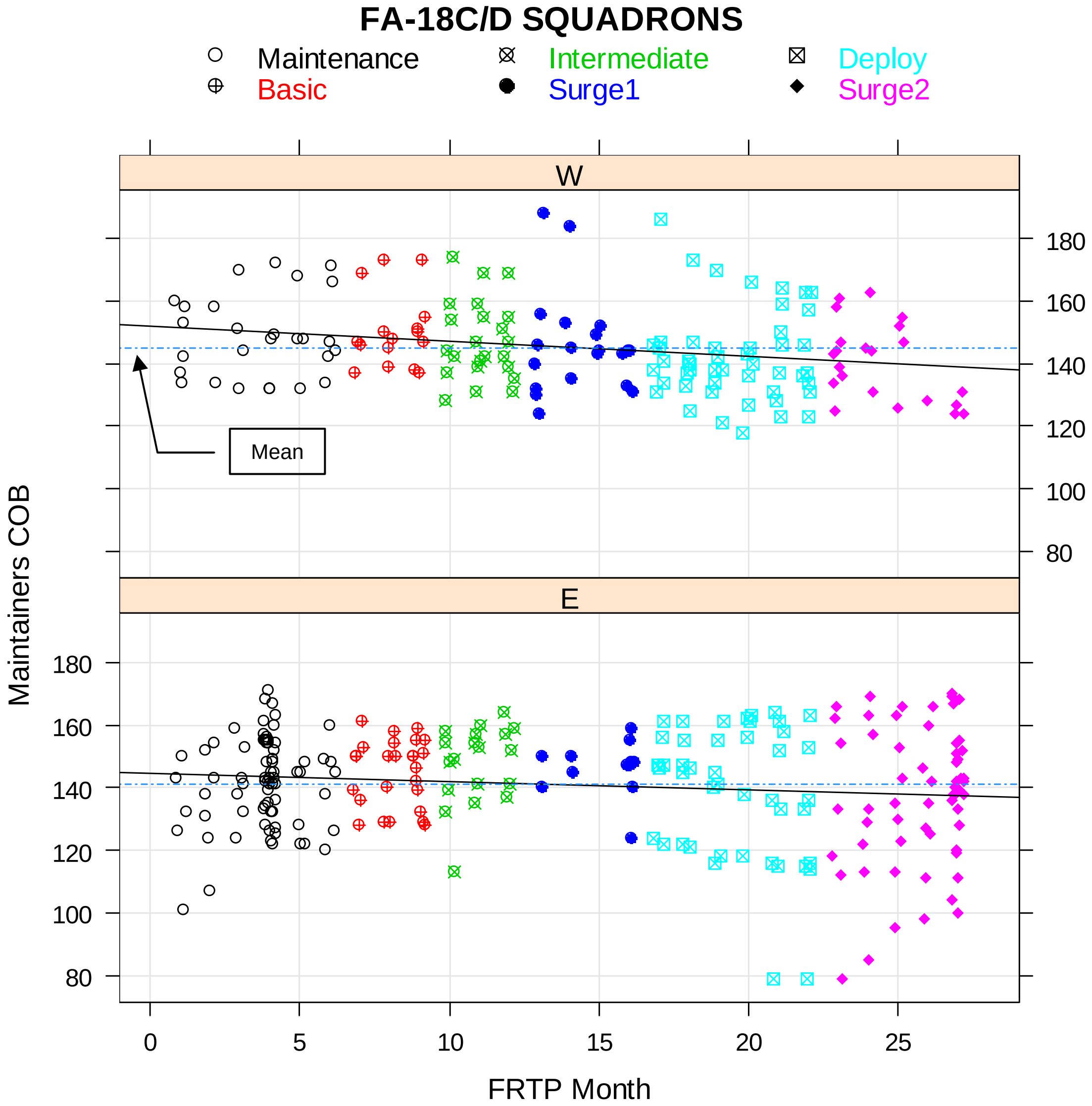

Figure 40. Maintainers COB Compared to FRTP Month for FA-18C/D Squadrons by Coast

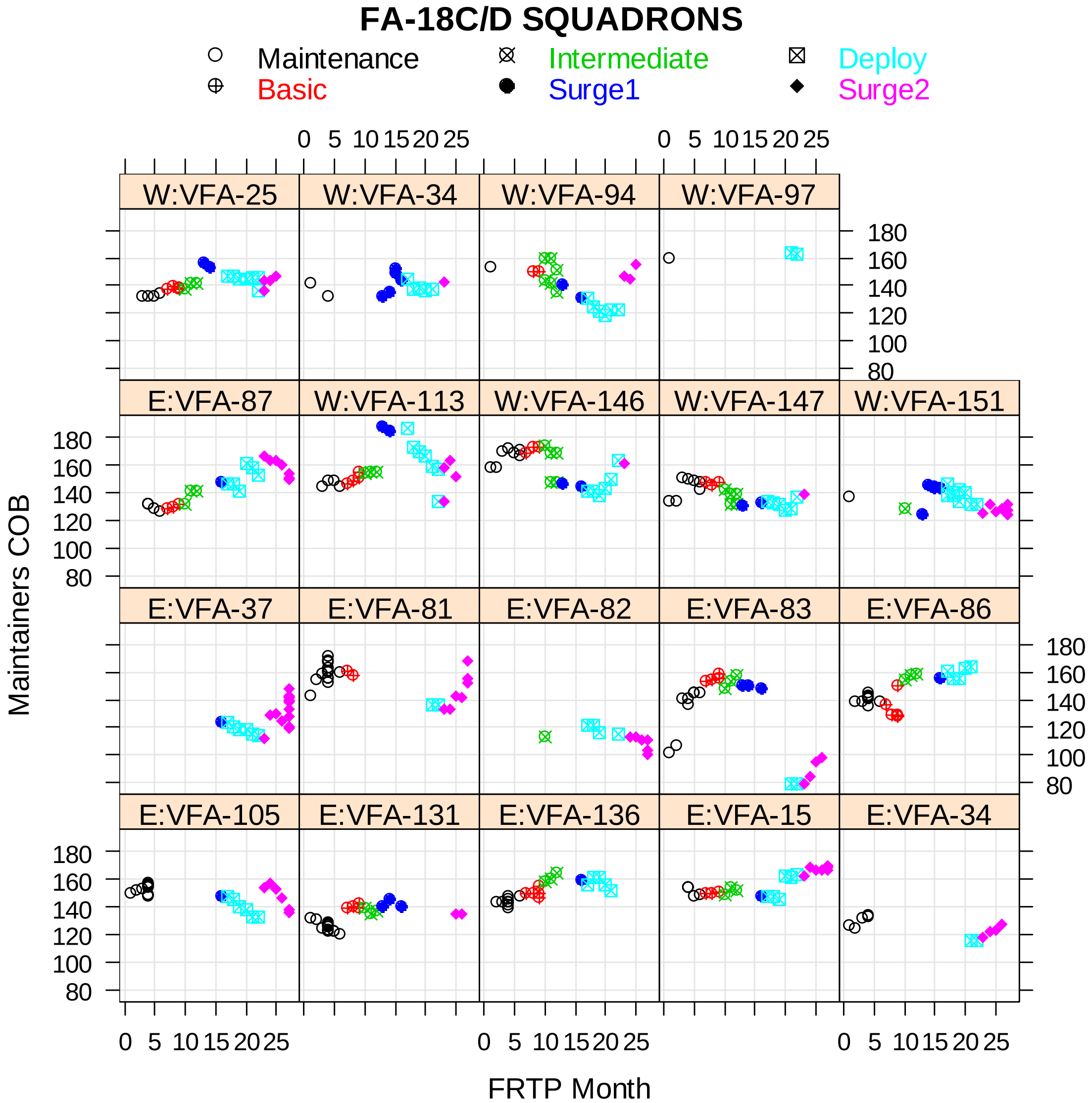

Figure 41. Maintainers COB Compared to FRTP Month for each FA-18C/D Squadrons

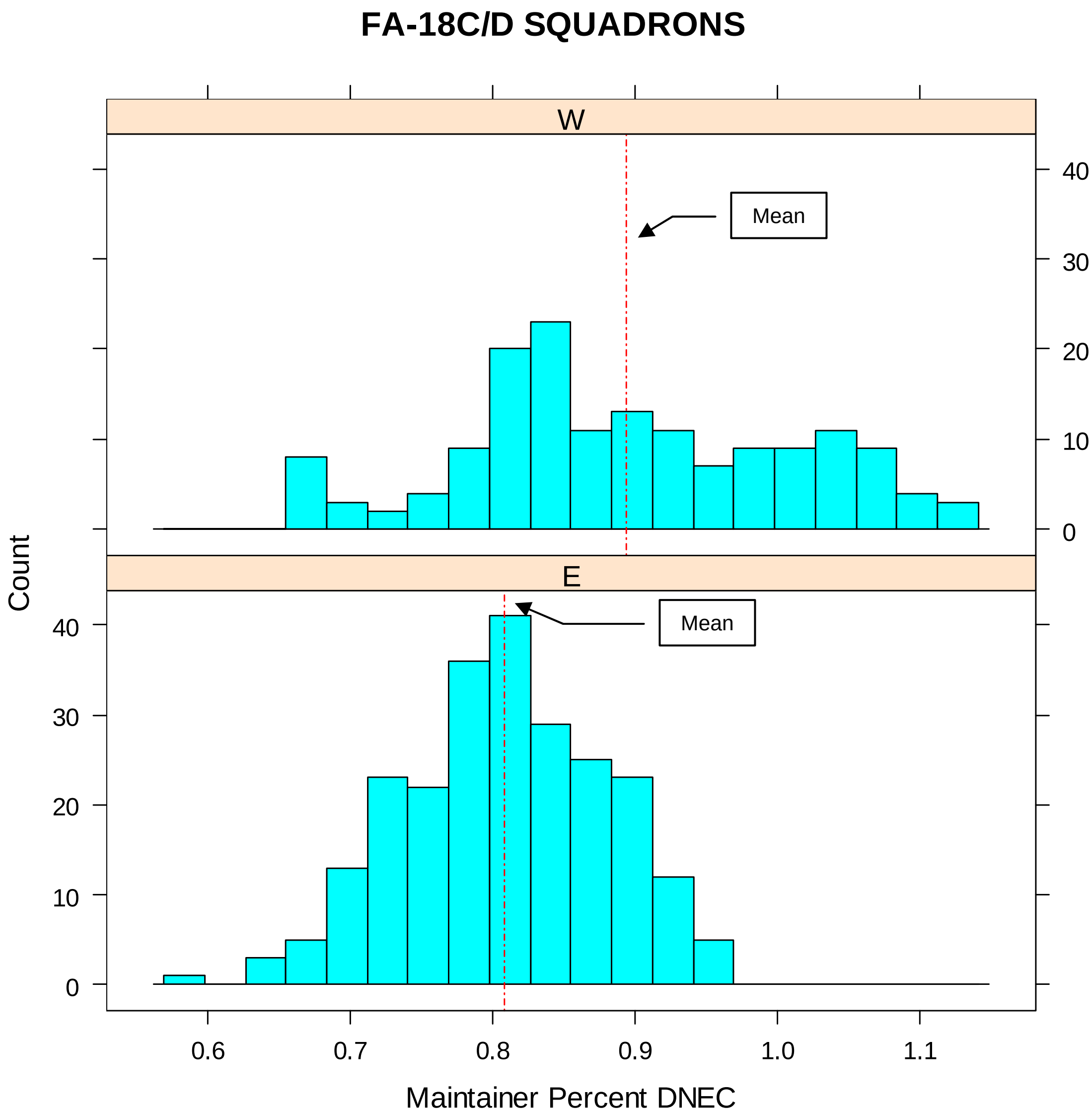

Figure 42. Histogram, Manpower Percent DNEC per Month for FA-18C/D Squadrons by Coast

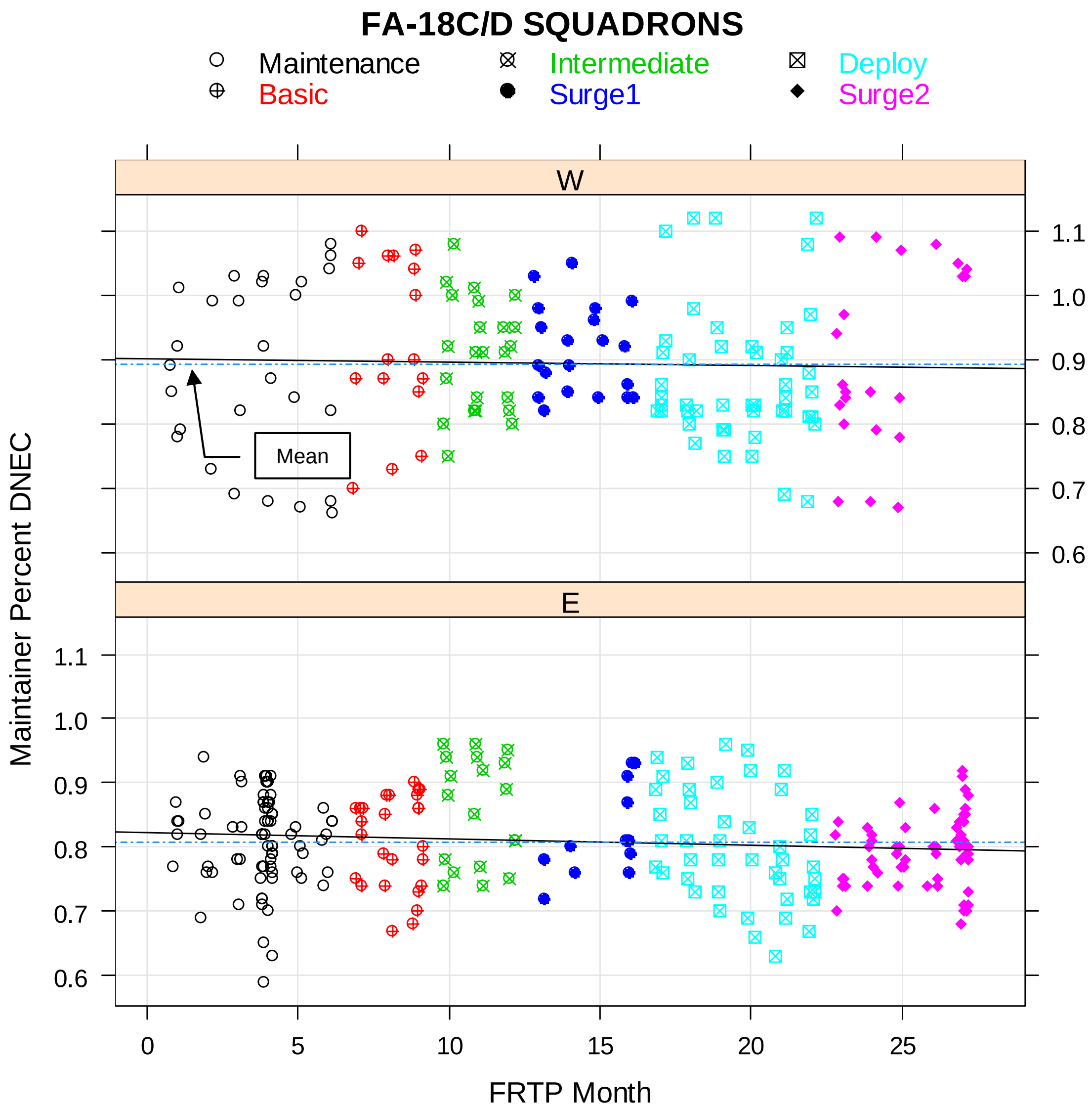

Figure 43. Manpower Percent DNEC compared to FRTP Month for FA-18C/D Squadrons by Coast

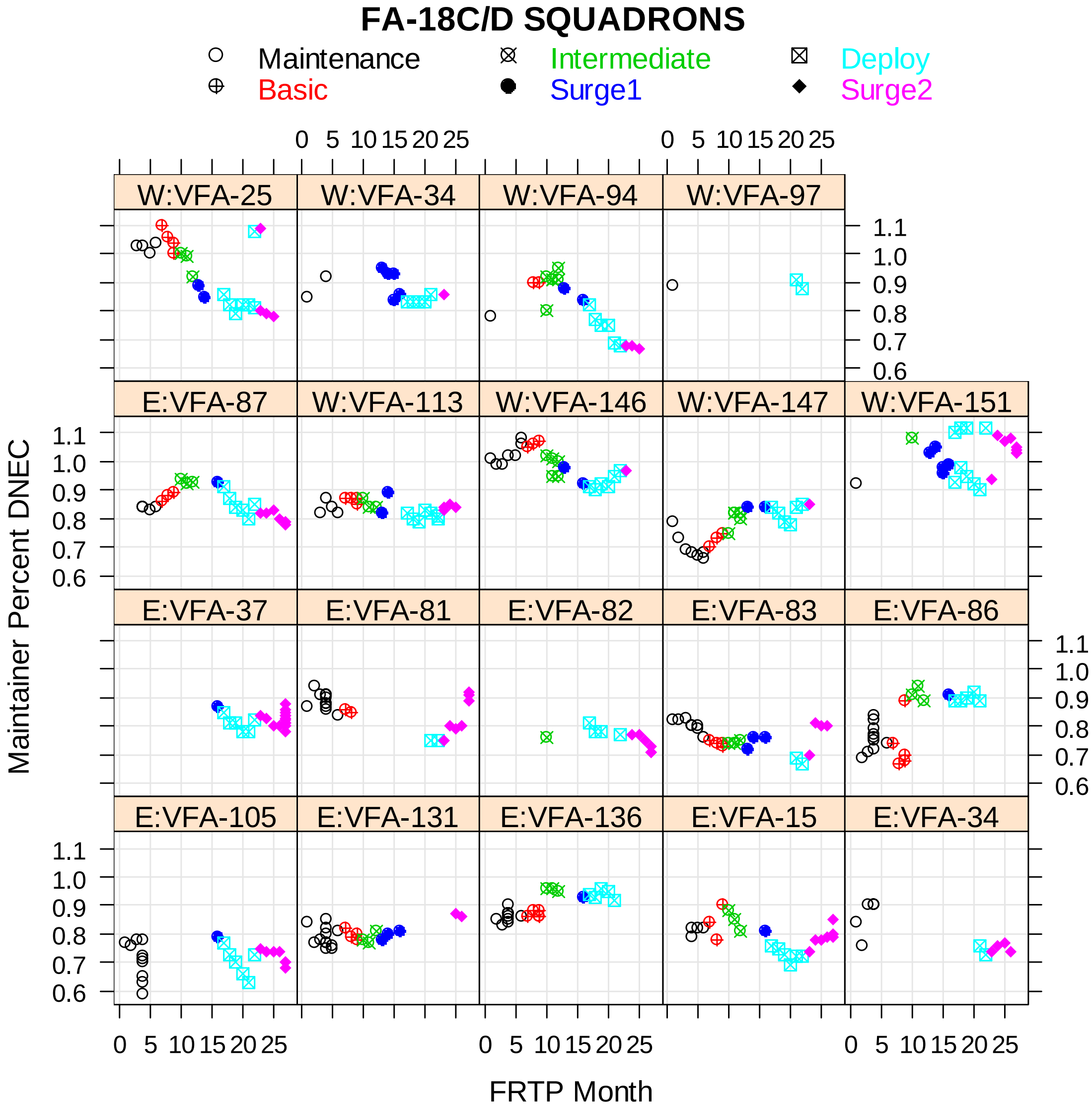

Figure 44. Manpower Percent DNEC compared to FRTP Month for each FA-18C/D Squadron

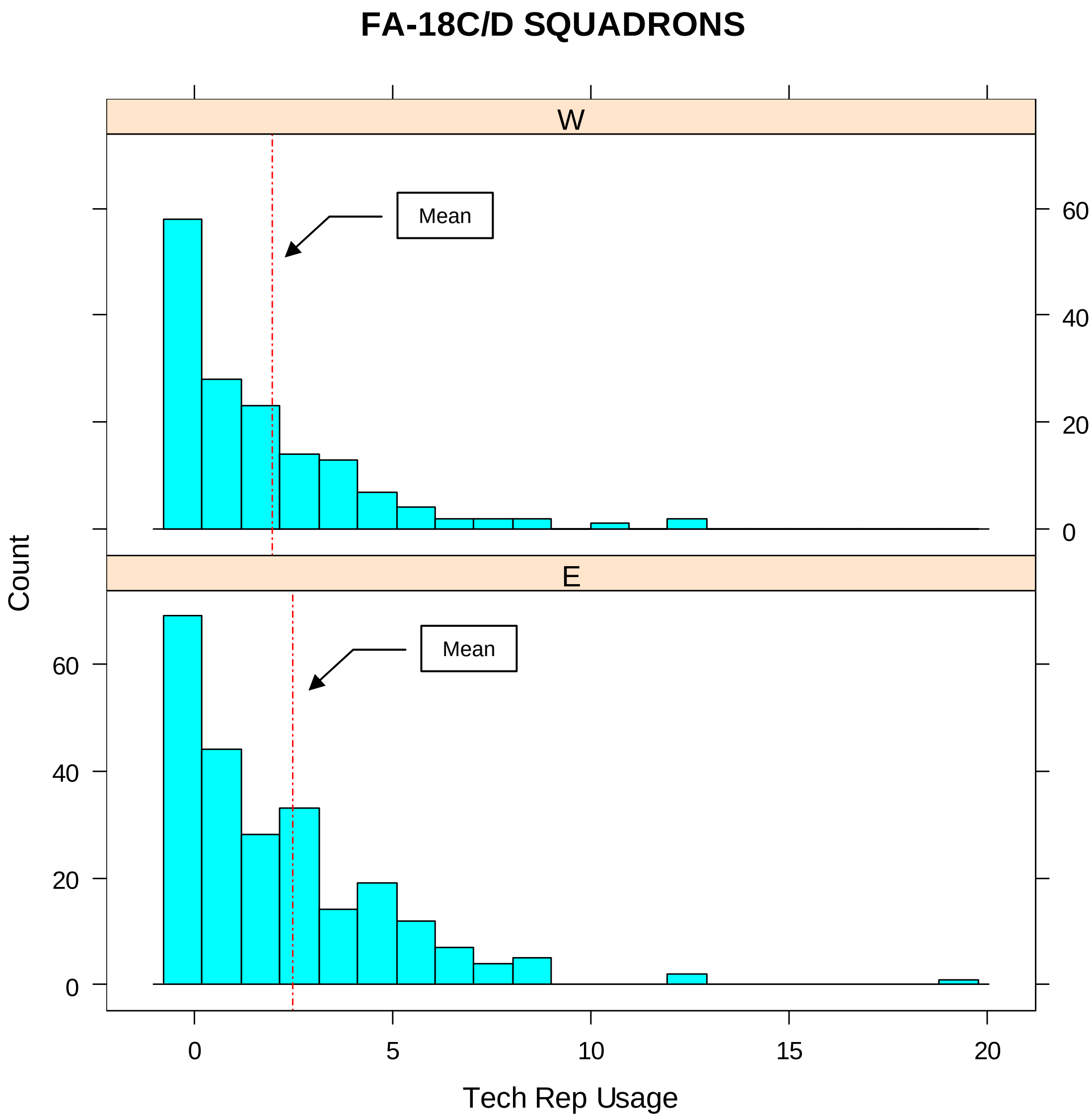

Figure 45. Histogram, Tech Rep usage per Month for FA-18C/D Squadrons by Coast

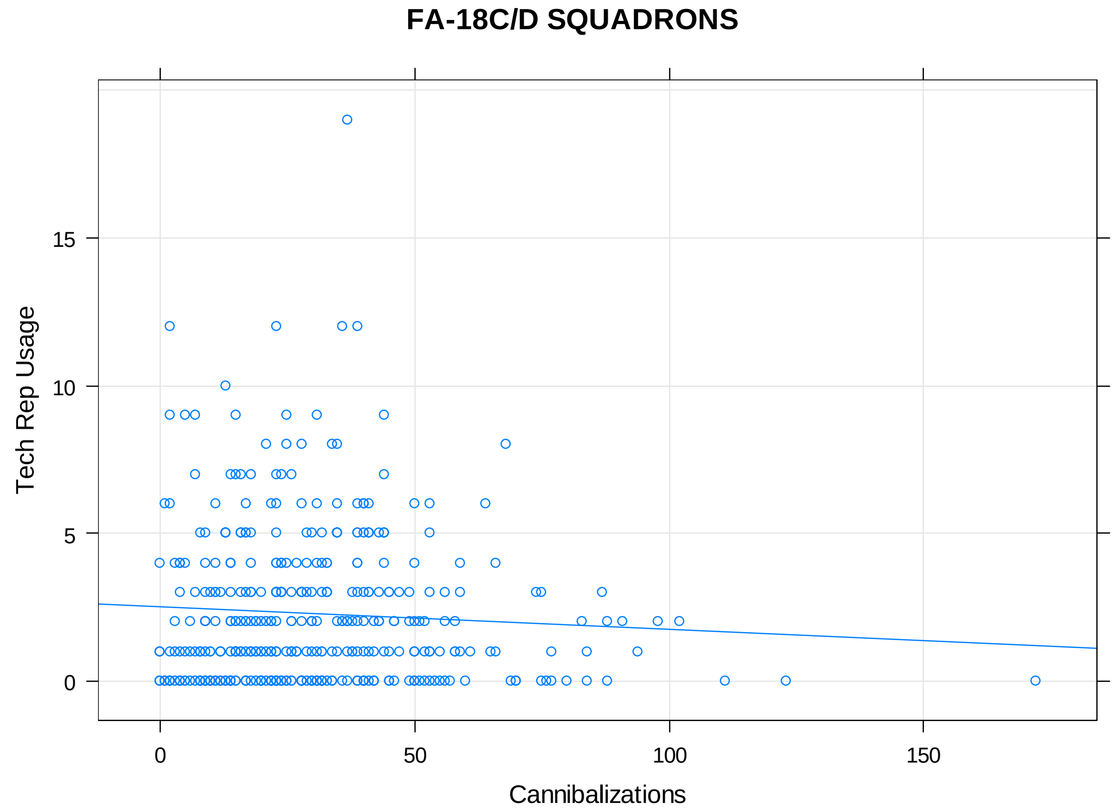

Figure 46. Tech Rep Usage compared to Cannibalizations per Month for FA-18C/D Squadrons

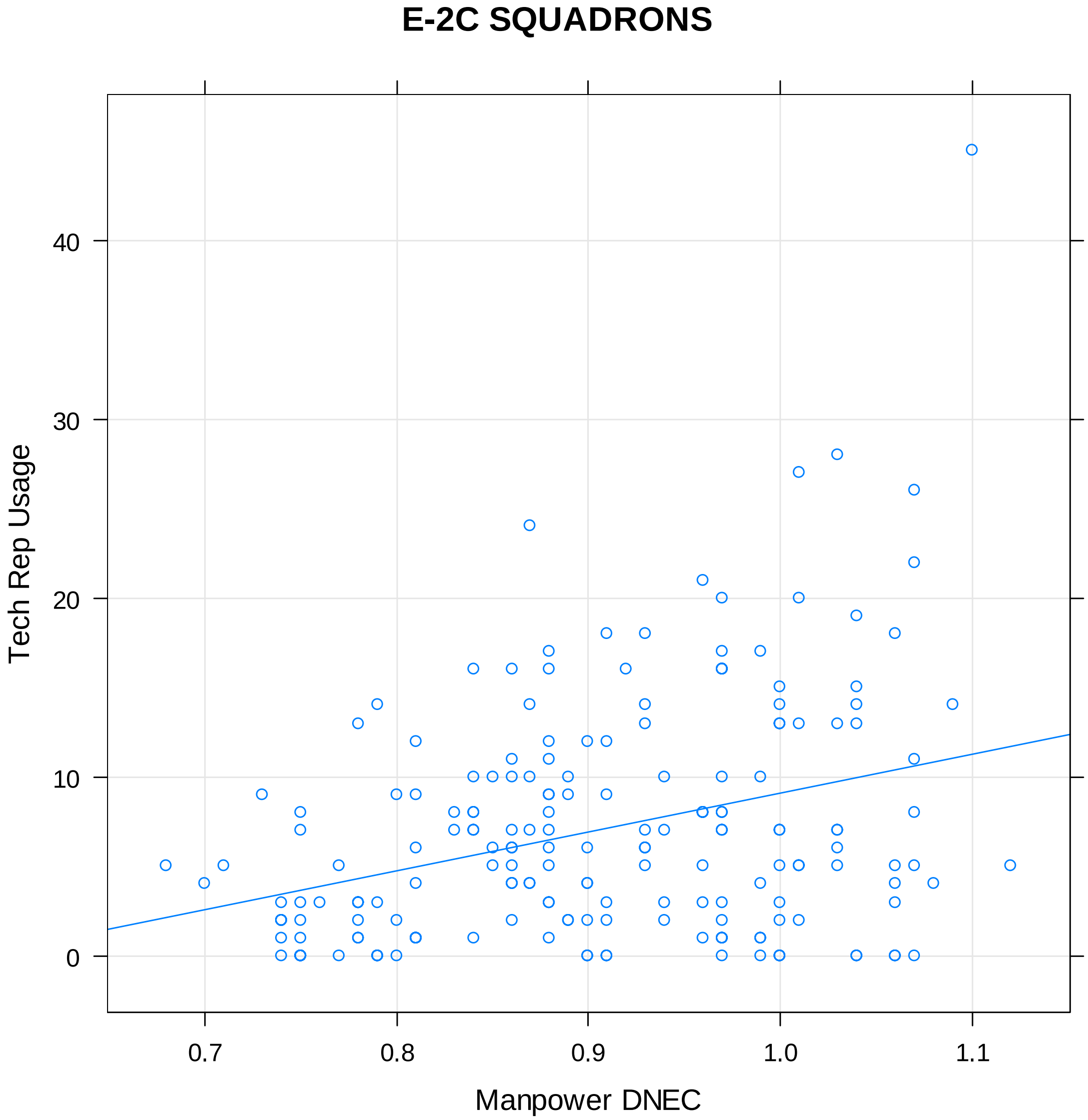

Figure 47. Tech Rep Usage compared to Manpower Percent DNEC per Month for E-2C Squadrons

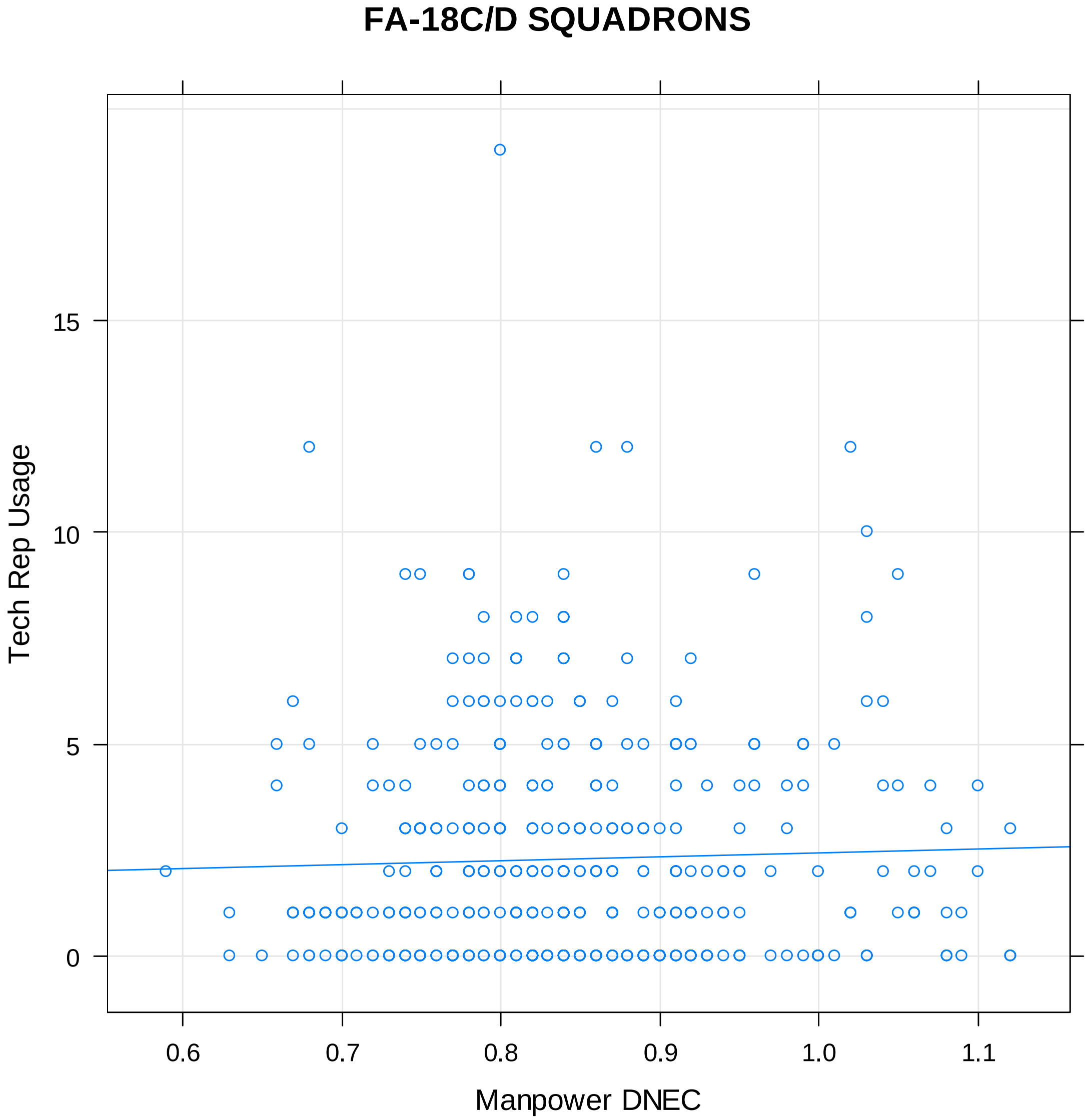

Figure 48. Tech Rep Usage compared to Manpower Percent DNEC per Month for FA-18C/D Squadrons

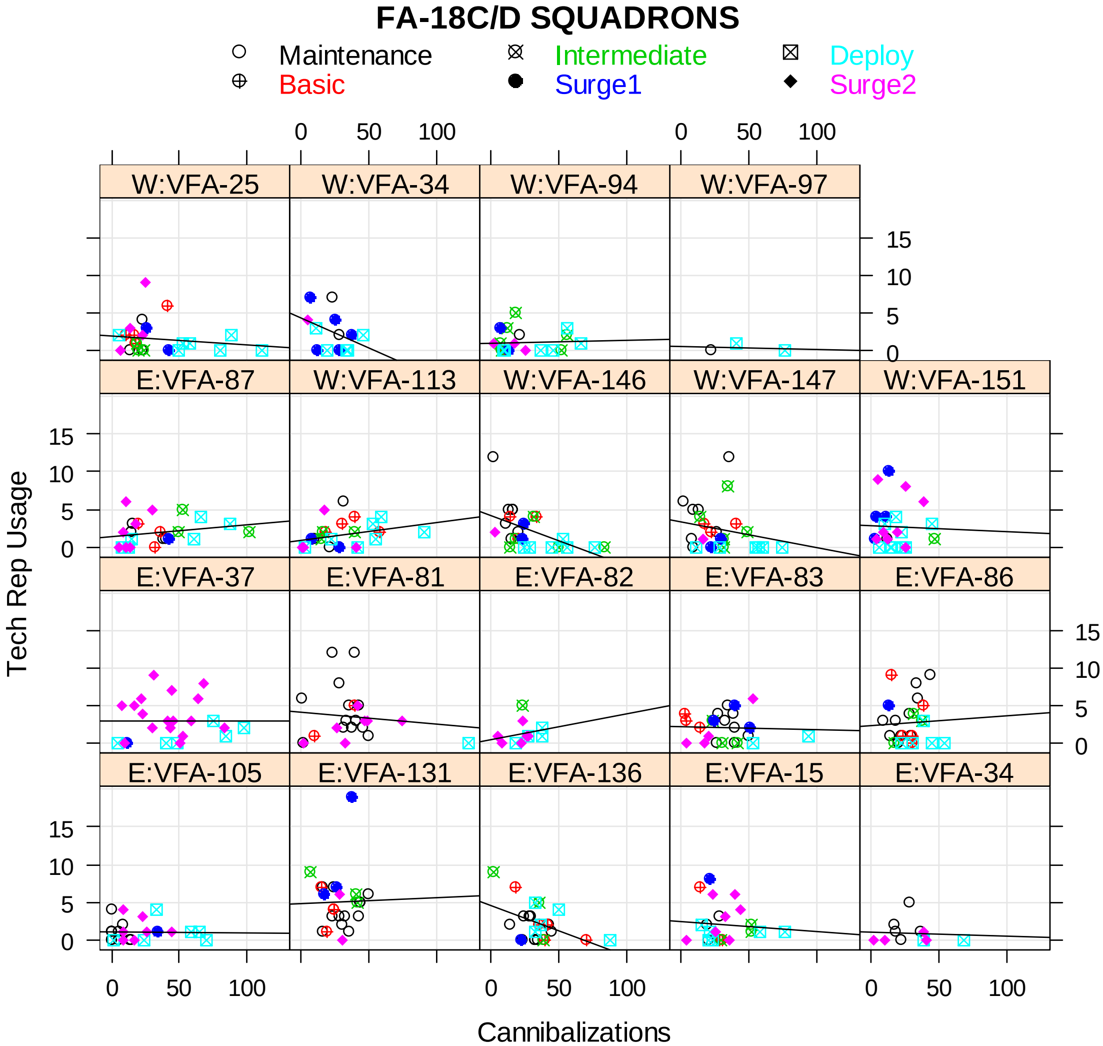

Figure 49. Tech Rep Usage compared to Cannibalizations per Month for each FA-18C/D Squadron (with Deployment Phase)

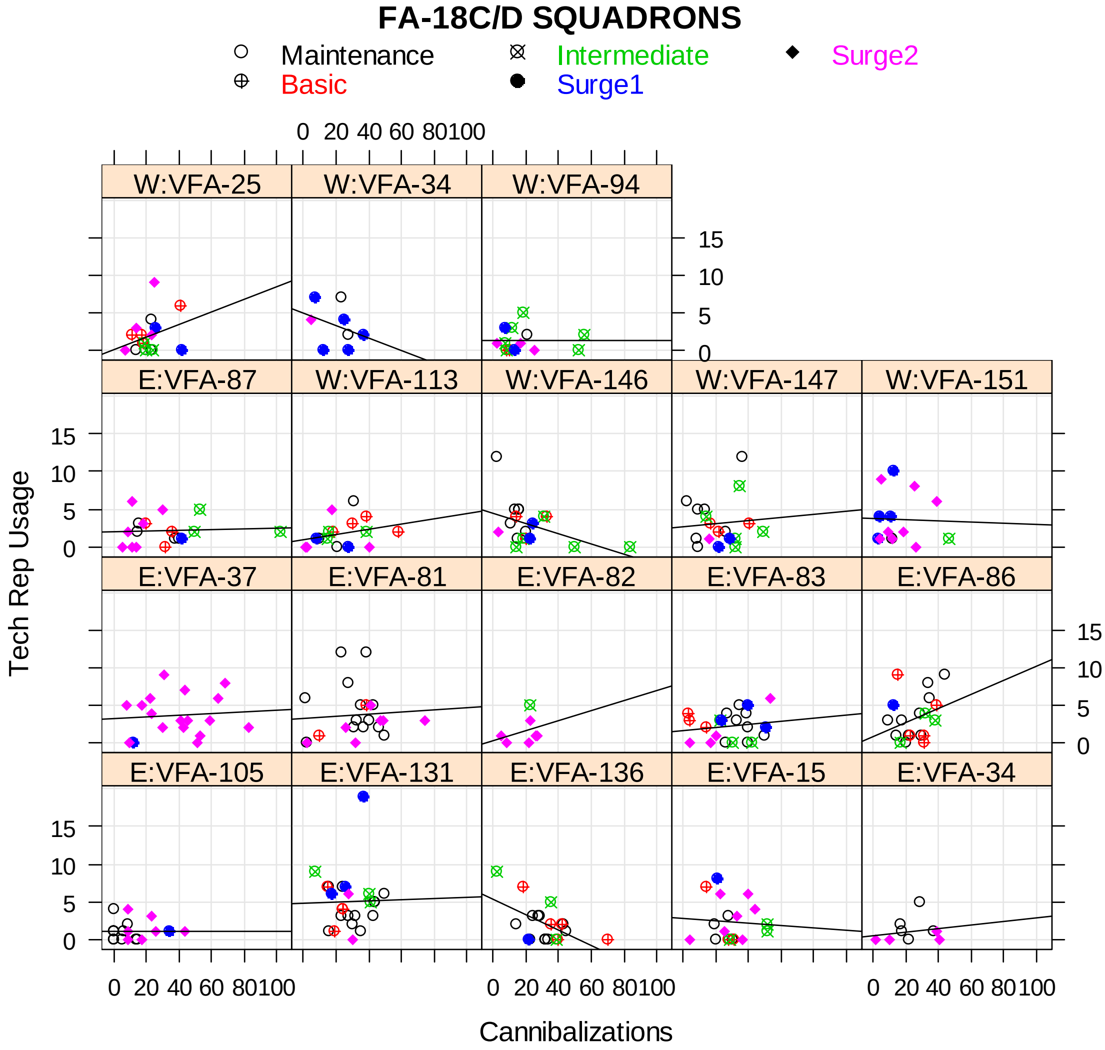

Figure 50. Tech Rep Usage compared to Cannibalizations per Month for each FA-18C/D Squadron (without Deployment Phase)

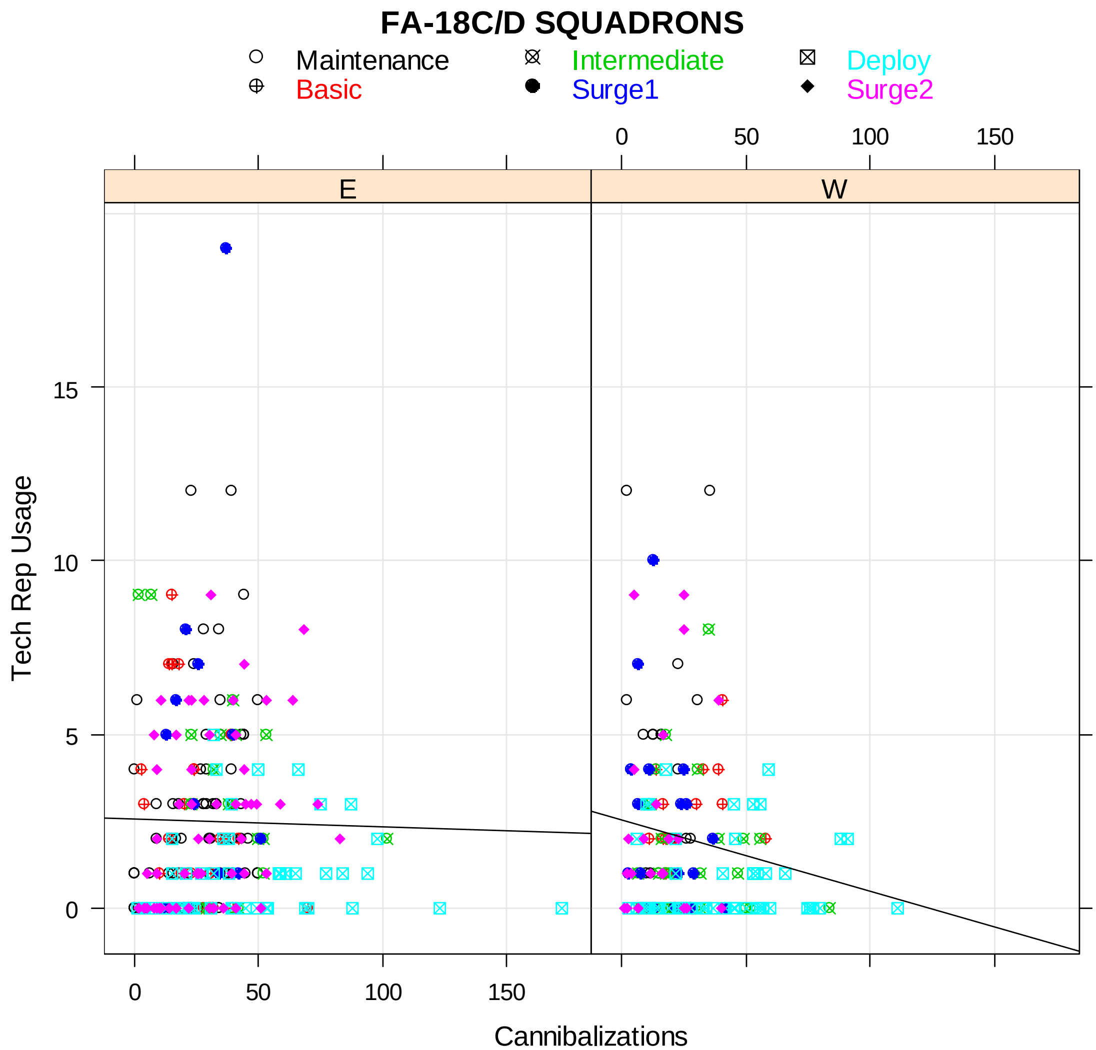

Figure 51. Tech Rep Usage compared to Cannibalizations per Month for E-2C Squadrons by Coast

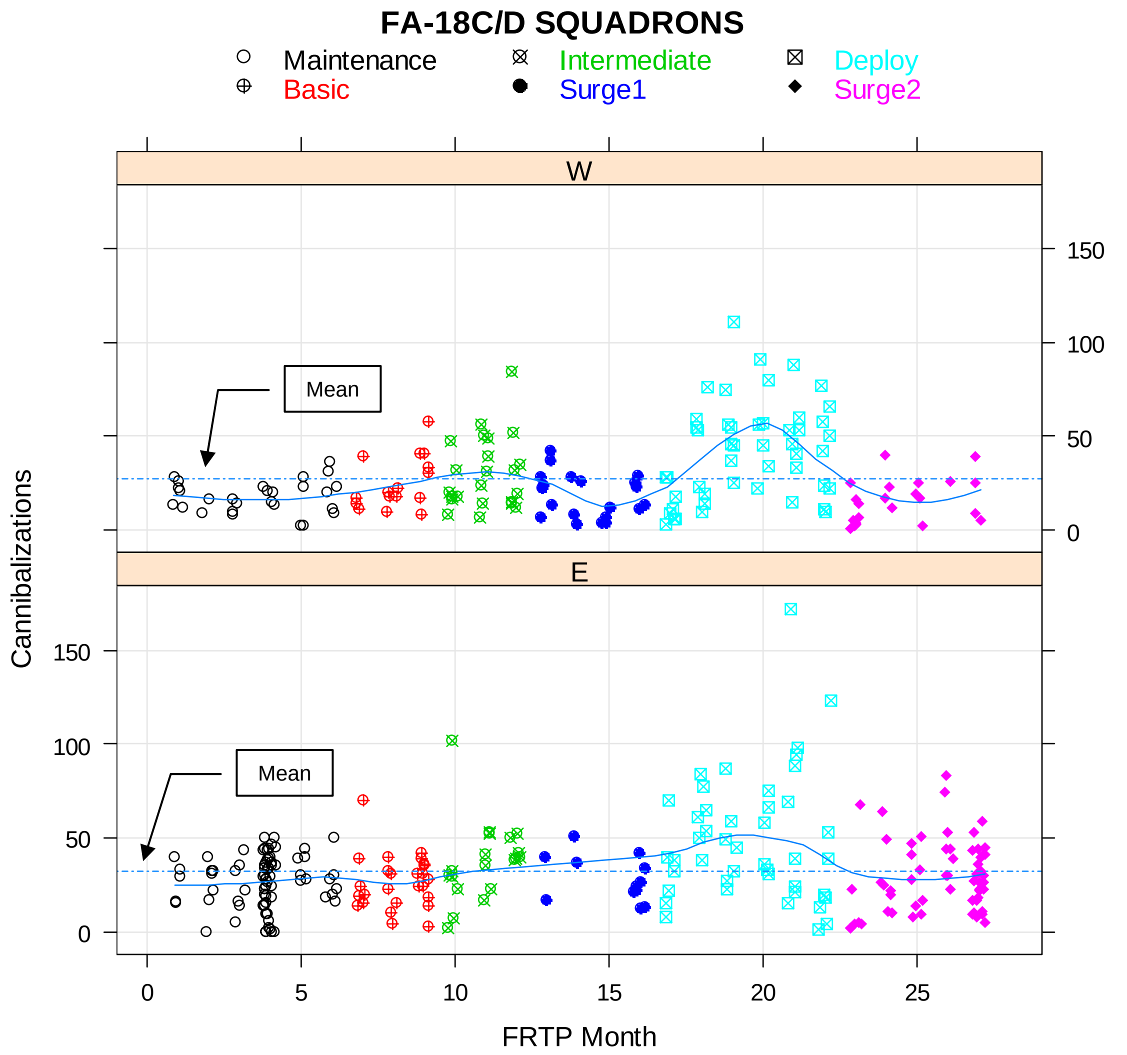

Figure 52. Cannibalizations compared to FRTP Month per Month for FA-18C/D Squadrons by Coast

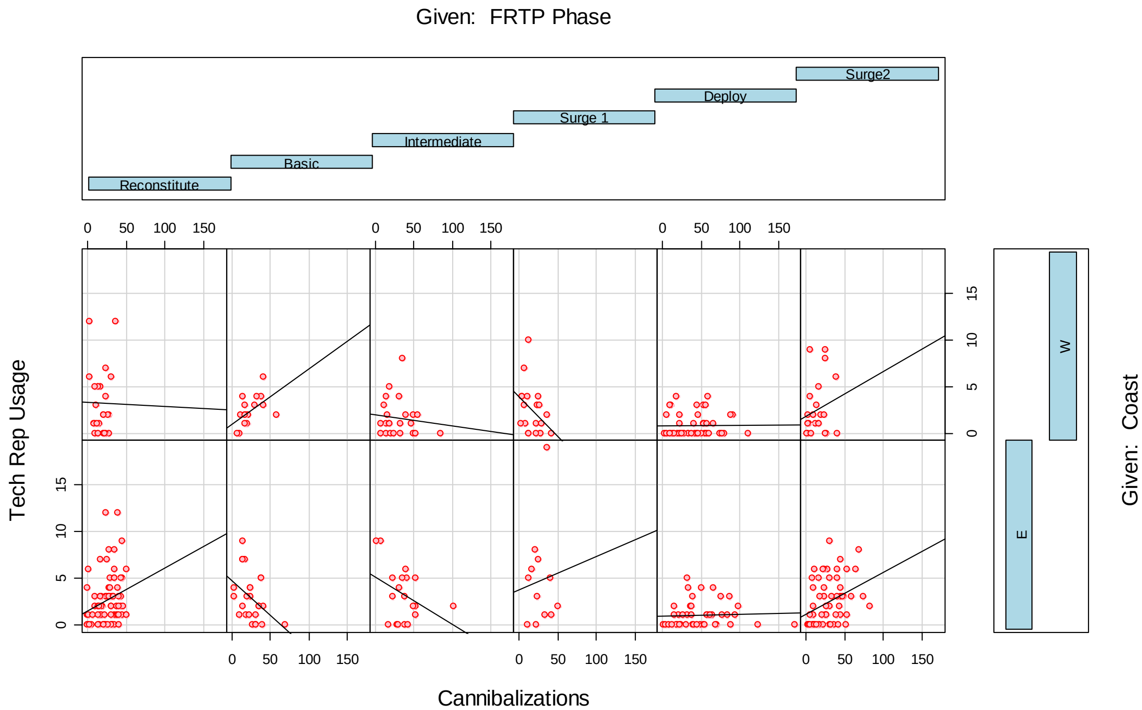

Figure 53. Cannibalizations compared to Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

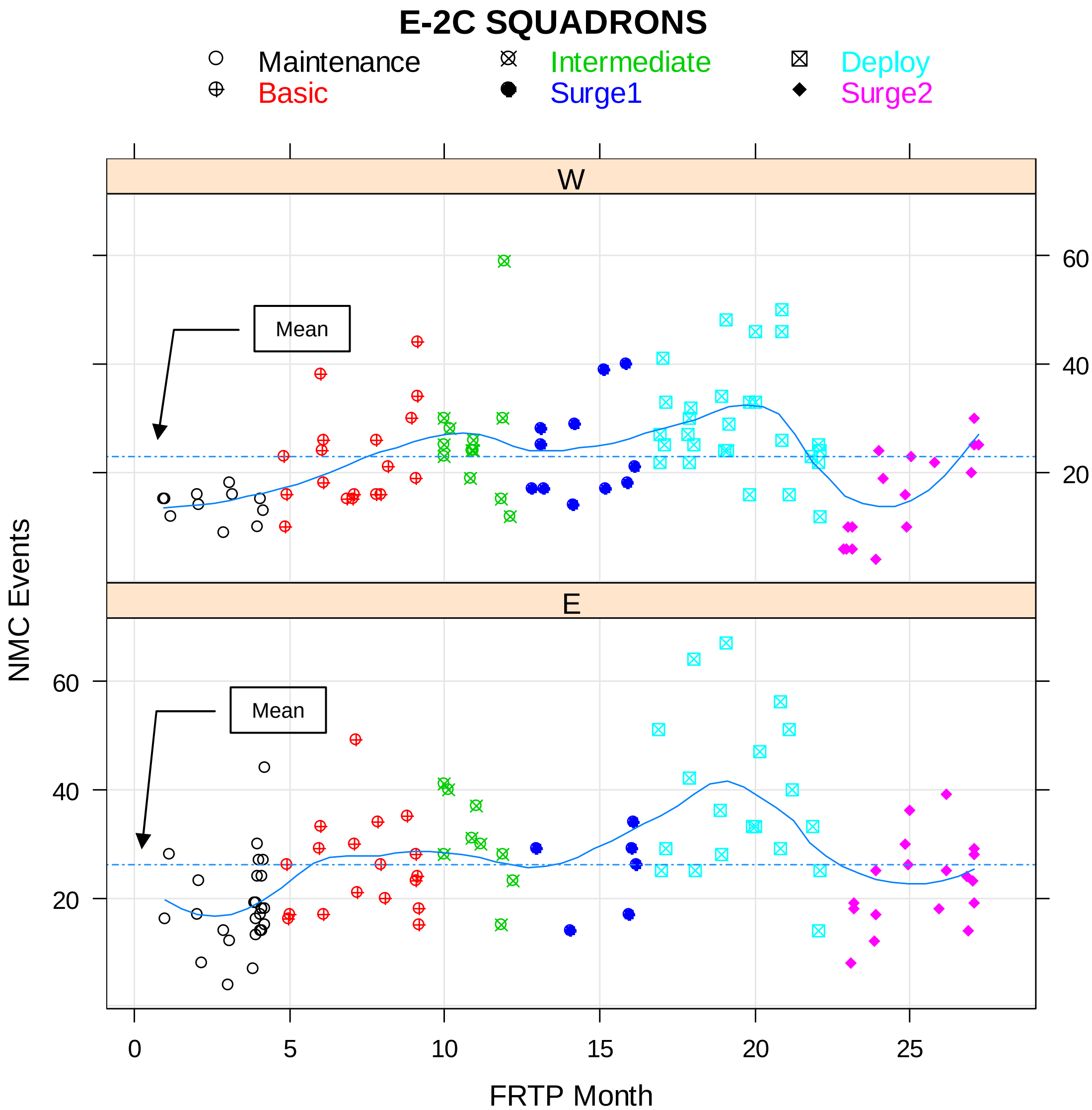

Figure 54. NMC Events compared to FRTP Month per Month for E-2C Squadrons by Coast

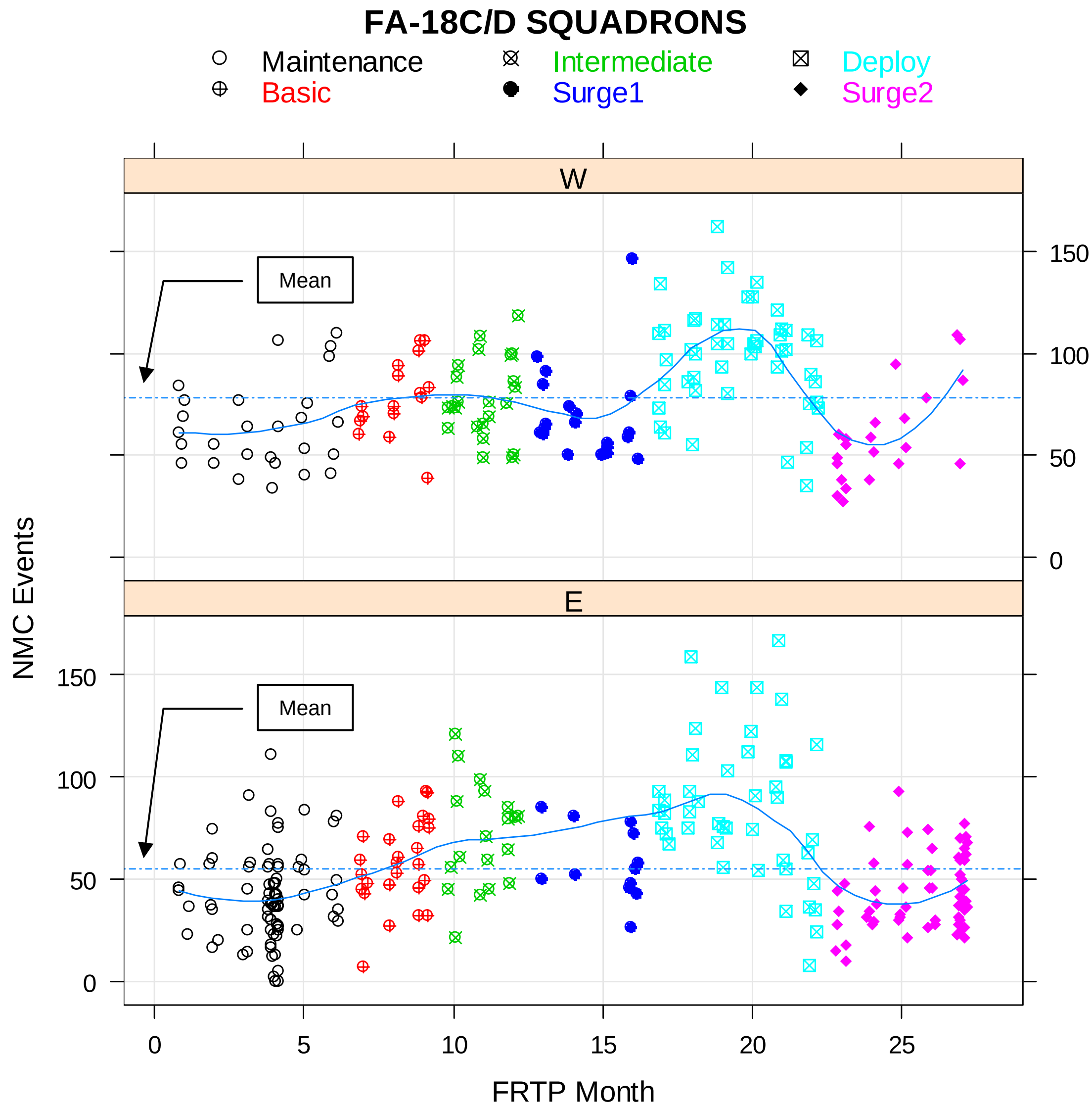

Figure 55. NMC Events compared to FRTP Month per Month for FA-18 Squadrons by Coast

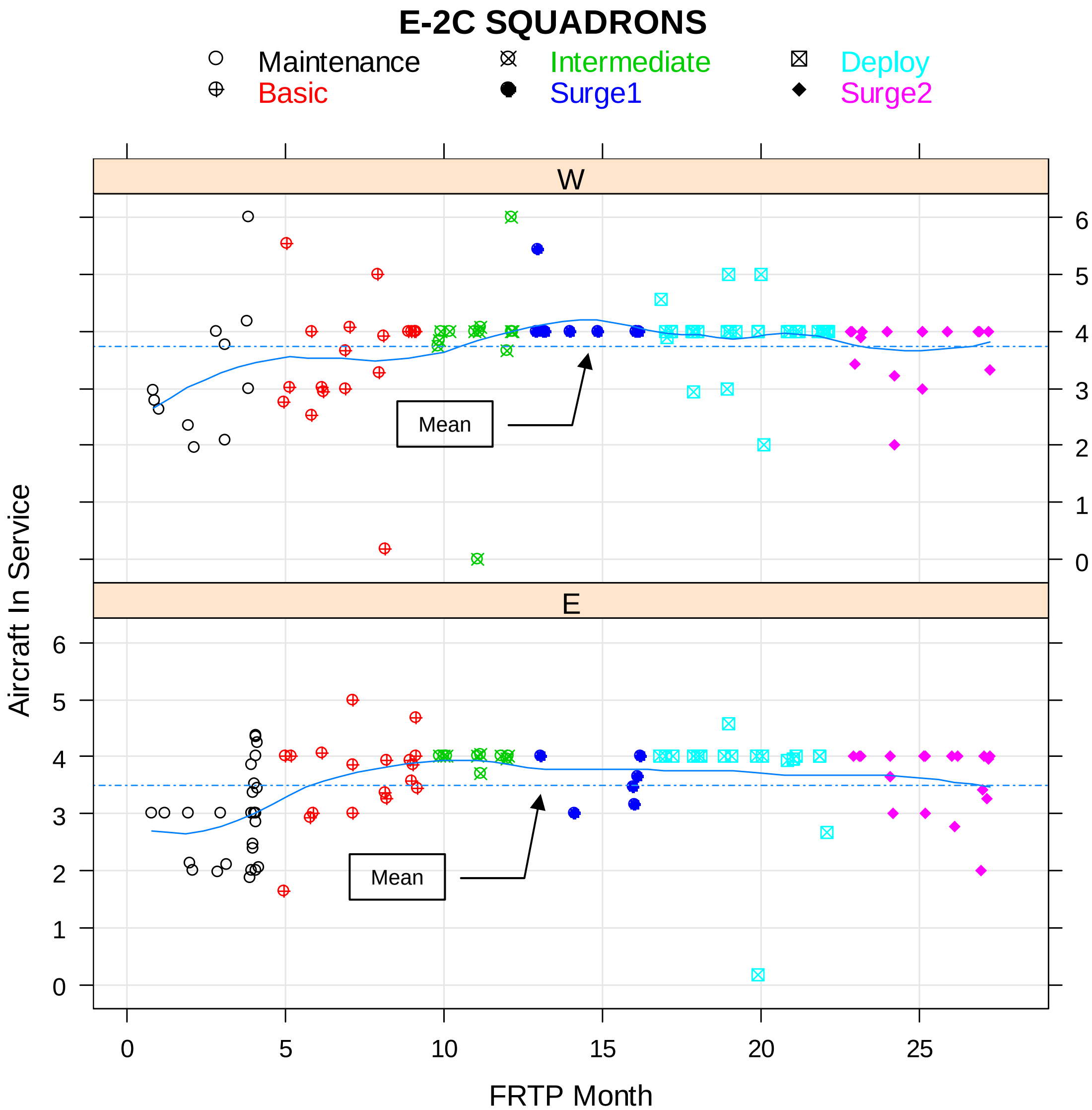

Figure 56. Aircraft In Service compared to FRTP Month per Month for E-2C Squadrons by Coast

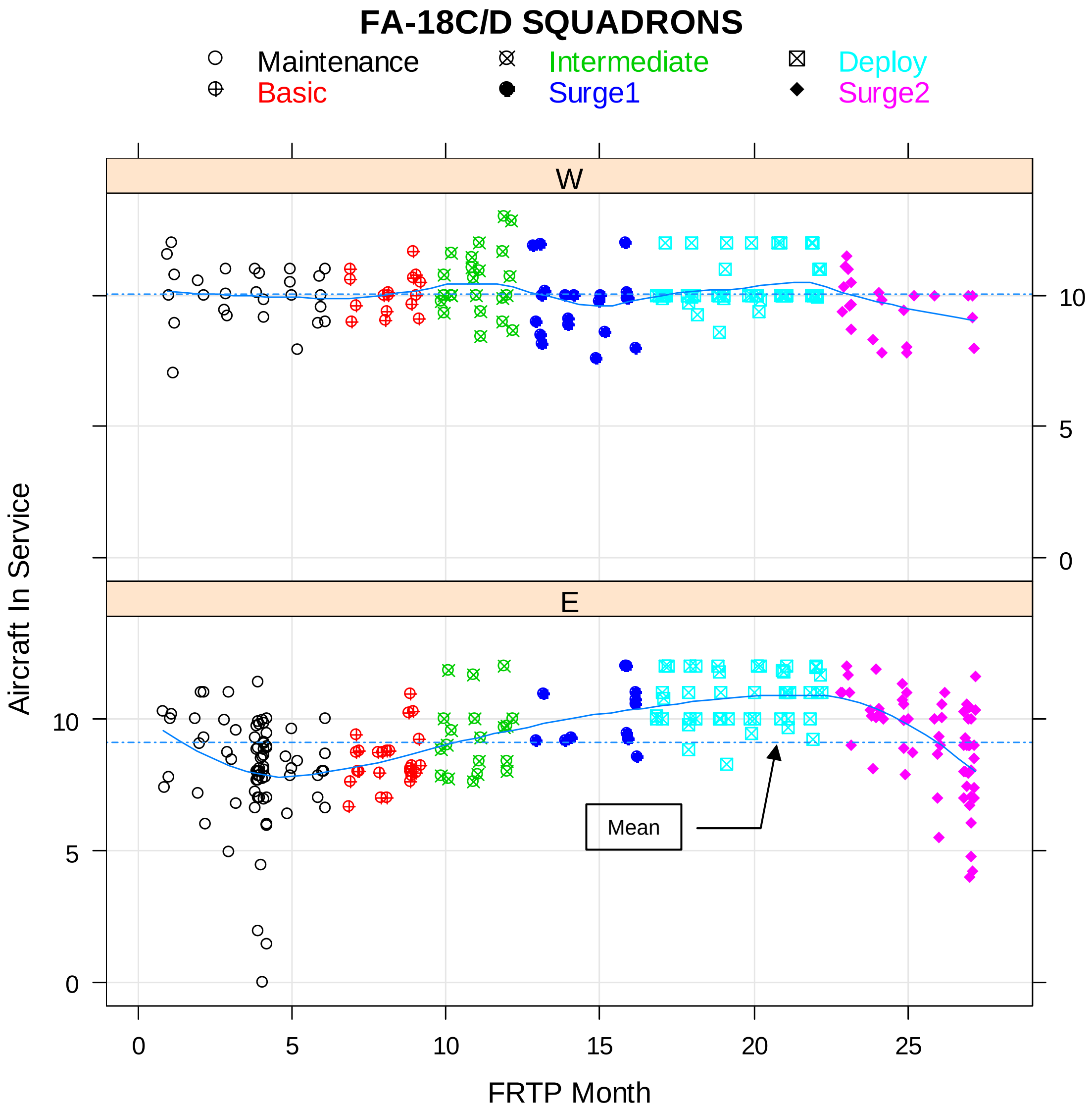

Figure 57. Aircraft In Service compared to FRTP Month per Month for FA-18C/D Squadrons by Coast

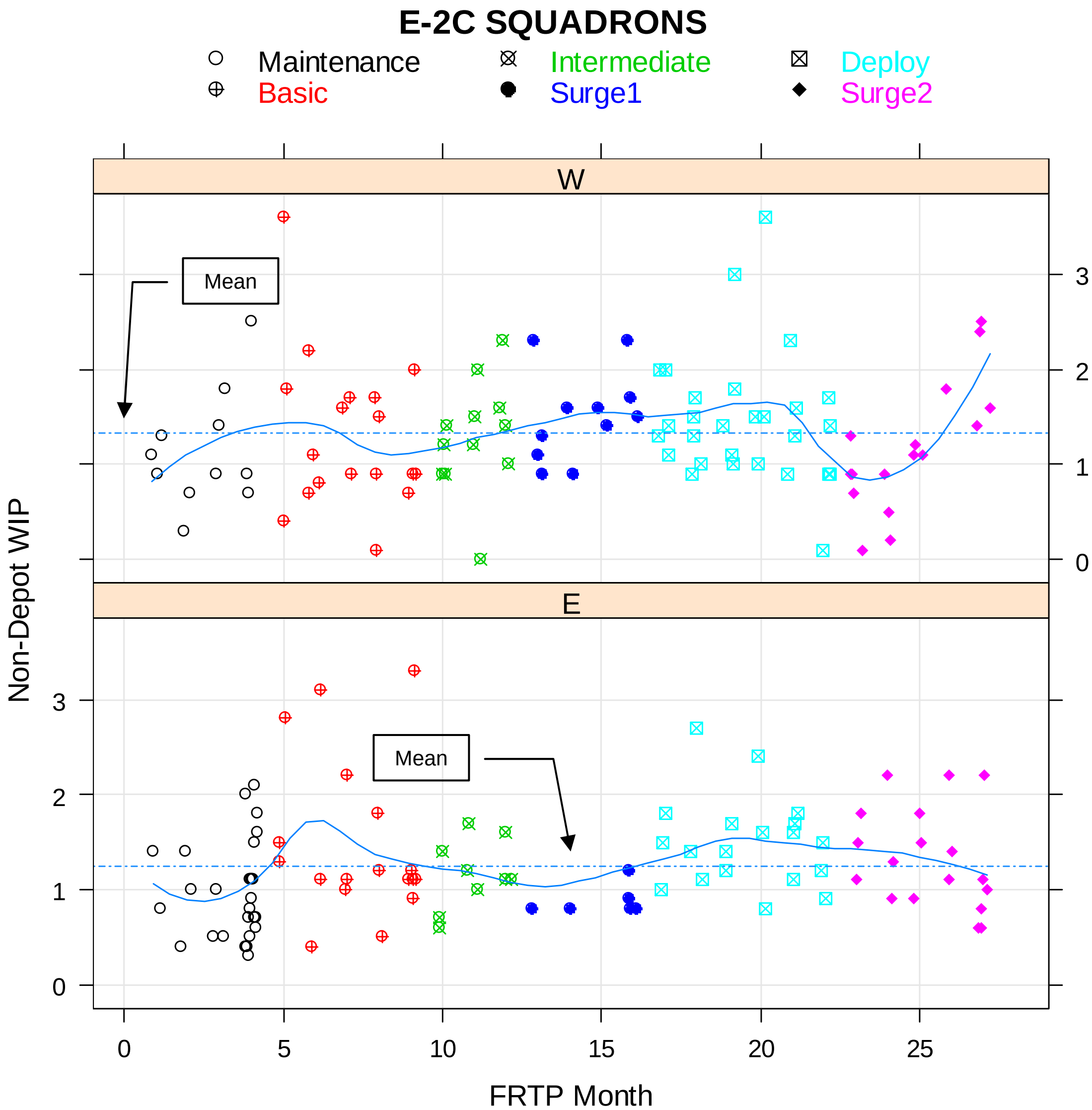

Figure 58. Non-Depot WIP compared to FRTP Month per Month for E-2C Squadrons by Coast

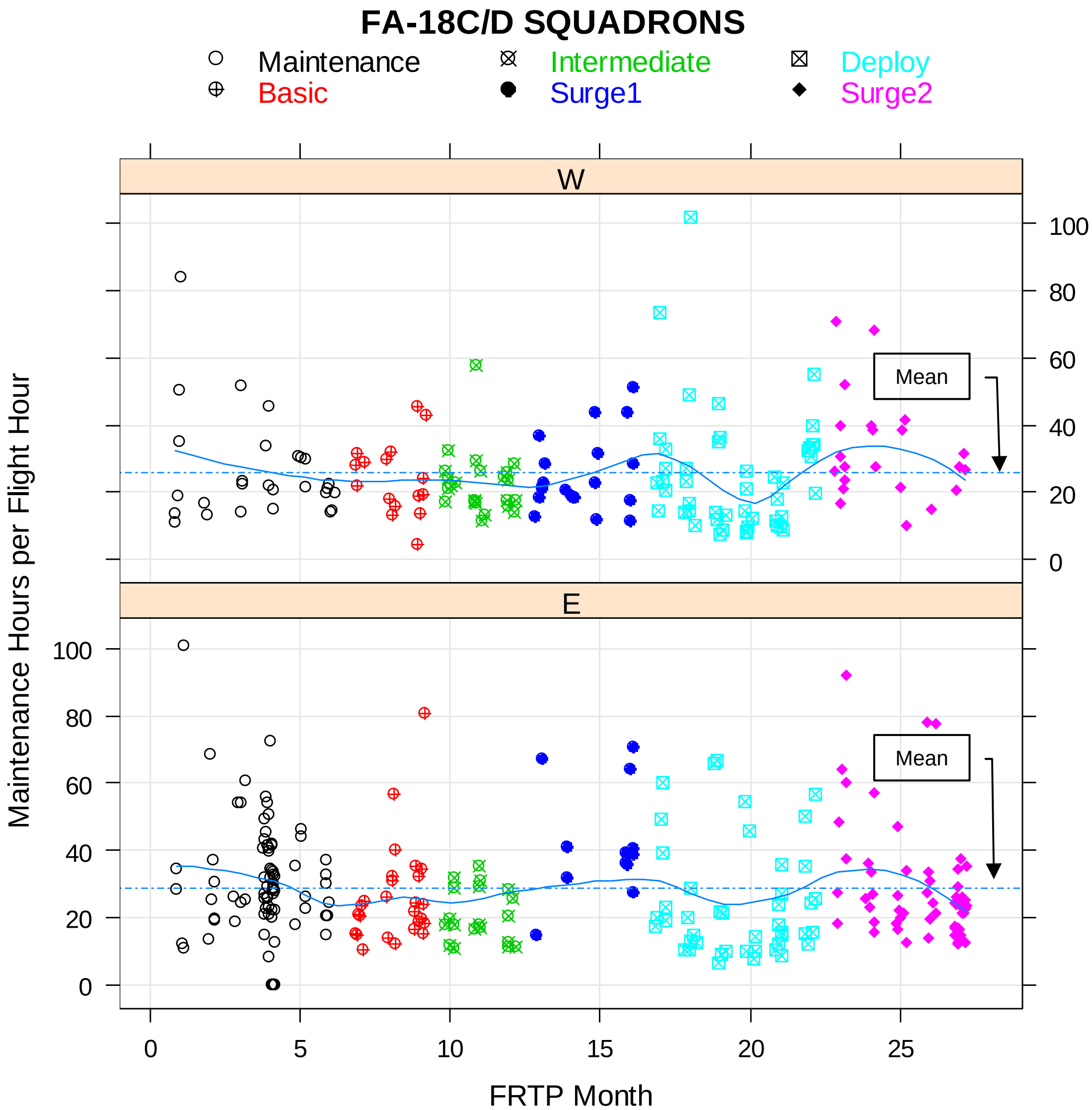

Figure 59. Maintenance Hours per Flight Hour compared to FRTP Month per Month for FA-18C/D Squadrons by Coast

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APPENDIX C. ADDITIONAL MODELING PLOTS AND TABLES

```
Call:
glm(formula = ElarCount ~ MnPwrDNEC + NonDepWIP + RftAct +
    MaintHrFltHr + Cann100FltHr + Coast + Rcat + NonDepWIP:Rcat +
    MaintHrFltHr:Rcat + Cann100FltHr:Rcat,
    family = "quasipoisson", data = data8.3)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-4.2697  -1.2626  -0.1257   0.9002   3.7796

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                   -0.699571   0.705705  -0.991 0.323564
MnPwrDNEC                      1.533531   0.630261   2.433 0.016468 *
NonDepWIP                      0.295459   0.124734   2.369 0.019474 *
RftAct                         0.271012   0.121508   2.230 0.027612 *
MaintHrFltHr                   0.025409   0.007667   3.314 0.001221 **
Cann100FltHr                  -0.029615   0.016658  -1.778 0.077999 .
CoastW                         0.727030   0.117901   6.166 1.01e-08 ***
RcatIntermediate               0.314453   0.428394   0.734 0.464388
RcatReconstitute               0.836110   0.376405   2.221 0.028238 *
RcatSurge 1                    1.002868   0.545771   1.838 0.068648 .
RcatSurge 2                   -0.198902   0.353689  -0.562 0.574935
NonDepWIP:RcatIntermediate    -1.096673   0.397581  -2.758 0.006735 **
NonDepWIP:RcatReconstitute    -0.306650   0.210582  -1.456 0.147992
NonDepWIP:RcatSurge 1         -0.878751   0.409827  -2.144 0.034068 *
NonDepWIP:RcatSurge 2          0.071845   0.207861   0.346 0.730227
MaintHrFltHr:RcatIntermediate  0.001296   0.016731   0.077 0.938370
MaintHrFltHr:RcatReconstitute -0.024493   0.009660  -2.536 0.012532 *
MaintHrFltHr:RcatSurge 1      -0.027716   0.015257  -1.817 0.071805 .
MaintHrFltHr:RcatSurge 2      -0.041782   0.010711  -3.901 0.000160 ***
Cann100FltHr:RcatIntermediate  0.050706   0.022479   2.256 0.025935 *
Cann100FltHr:RcatReconstitute  0.024055   0.019409   1.239 0.217678
Cann100FltHr:RcatSurge 1       0.046290   0.023805   1.945 0.054204 .
Cann100FltHr:RcatSurge 2       0.073428   0.022243   3.301 0.001274 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for quasipoisson family taken to be 2.573655)

    Null deviance: 683.90  on 140  degrees of freedom
Residual deviance: 335.85  on 118  degrees of freedom
AIC: NA

Number of Fisher Scoring iterations: 5
```

Table 11. E-2C Log Linear Model Coefficients and Standard Errors

```
Call:
glm(formula = ElarCount ~ MnPwrDNEC + AVDLR + AfmOther + log(RftAct +
    ((RftAct == 0) * 0.1)) + Cann100FltHr + Cann100FltHr^2 +
    FltHrNmc + Coast + Rcat + MnPwrDNEC:Coast + MnPwrDNEC:Rcat +
    AfmOther:Rcat + RftAct:Rcat + Cann100FltHr:Coast, family = quasipoisson,
    data = data9.3)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.3771  -1.4604  -0.2819   0.8270   4.2581

Coefficients:
                                      Estimate Std. Error t value Pr(>|t|)
(Intercept)                         -2.754e+00  1.613e+00  -1.708  0.08879 .
MnPwrDNEC                            3.493e+00  1.873e+00   1.865  0.06332 .
AVDLR                                6.010e-07  1.692e-07   3.552  0.00045 ***
AfmOther                             9.674e-07  2.488e-06   0.389  0.69776
log(RftAct + ((RftAct == 0) * 0.1))  1.835e+00  9.370e-01   1.958  0.05126 .
Cann100FltHr                         1.541e-02  8.387e-03   1.838  0.06722 .
FltHrNmc                             3.134e-02  1.882e-02   1.665  0.09699 .
CoastW                               3.527e+00  1.204e+00   2.928  0.00370 **
RcatIntermediate                     4.824e+00  2.377e+00   2.030  0.04335 *
RcatReconstitute                     8.627e-01  1.644e+00   0.525  0.60014
RcatSurge 1                         -2.961e+00  2.586e+00  -1.145  0.25322
RcatSurge 2                         -2.166e+00  1.706e+00  -1.269  0.20538
MnPwrDNEC:CoastW                    -3.729e+00  1.417e+00  -2.632  0.00898 **
MnPwrDNEC:RcatIntermediate          -5.318e+00  2.389e+00  -2.226  0.02681 *
MnPwrDNEC:RcatReconstitute          -1.079e+00  1.809e+00  -0.597  0.55126
MnPwrDNEC:RcatSurge 1               -1.380e+00  2.508e+00  -0.550  0.58273
MnPwrDNEC:RcatSurge 2                9.679e-01  1.838e+00   0.527  0.59882
AfmOther:RcatIntermediate           -3.721e-06  4.486e-06  -0.830  0.40752
AfmOther:RcatReconstitute            7.340e-07  2.950e-06   0.249  0.80369
AfmOther:RcatSurge 1                 1.621e-05  5.068e-06   3.198  0.00155 **
AfmOther:RcatSurge 2                 3.108e-06  2.983e-06   1.042  0.29831
RcatBasic:RftAct                    -6.060e-01  2.665e-01  -2.274  0.02373 *
RcatIntermediate:RftAct             -5.773e-01  2.338e-01  -2.469  0.01416 *
RcatReconstitute:RftAct             -5.920e-01  2.710e-01  -2.185  0.02977 *
RcatSurge 1:RftAct                  -9.283e-02  2.338e-01  -0.397  0.69163
RcatSurge 2:RftAct                  -4.018e-01  2.179e-01  -1.844  0.06631 .
Cann100FltHr:CoastW                 -3.382e-02  2.121e-02  -1.594  0.11202
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for quasipoisson family taken to be 2.209117)

    Null deviance: 867.27  on 300  degrees of freedom
Residual deviance: 665.02  on 274  degrees of freedom
AIC: NA

Number of Fisher Scoring iterations: 5
```

Table 12. FA-18C/D Log Linear Model Coefficients and Standard Errors

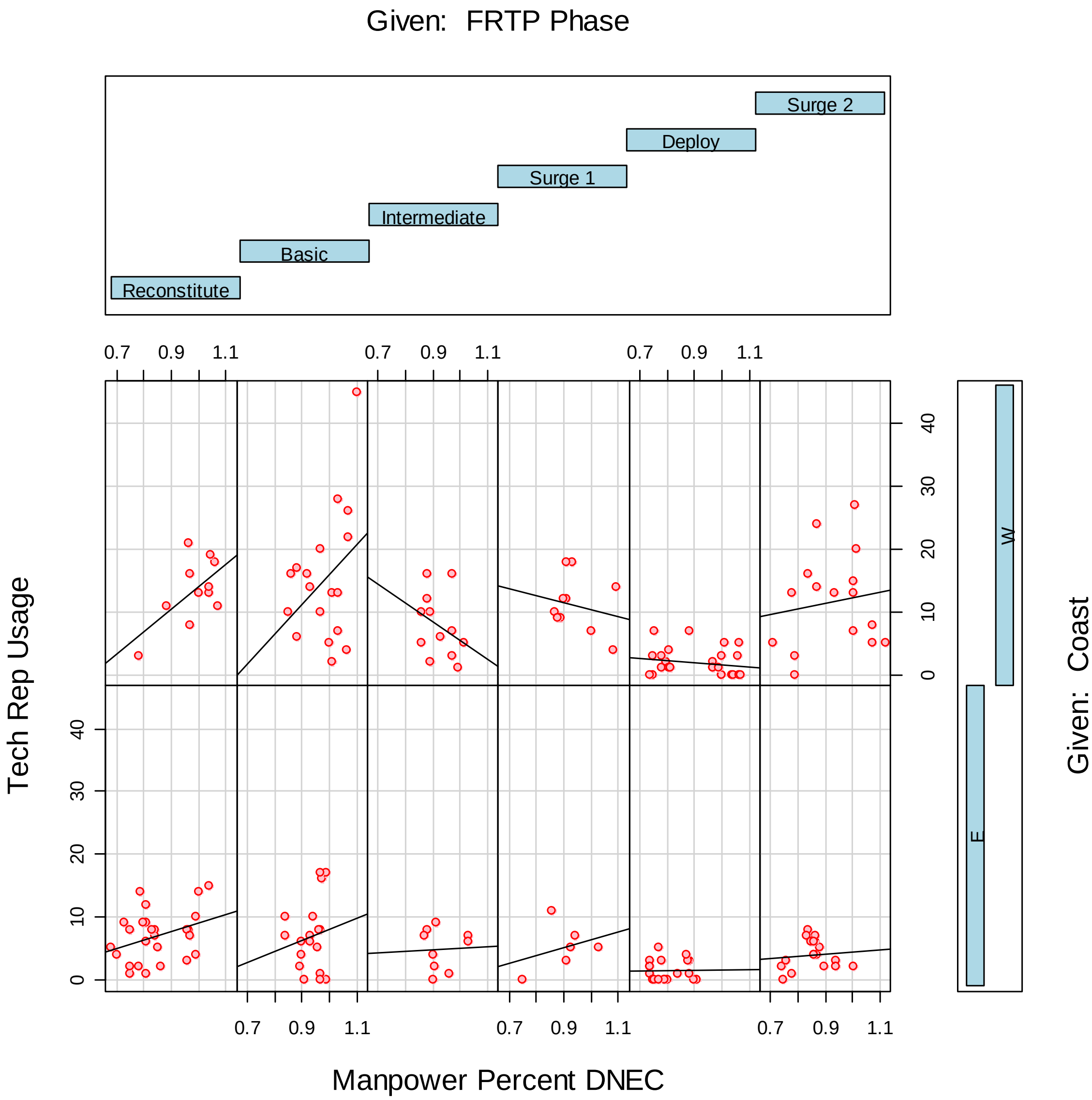

Figure 60. Manpower Percent DNEC compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

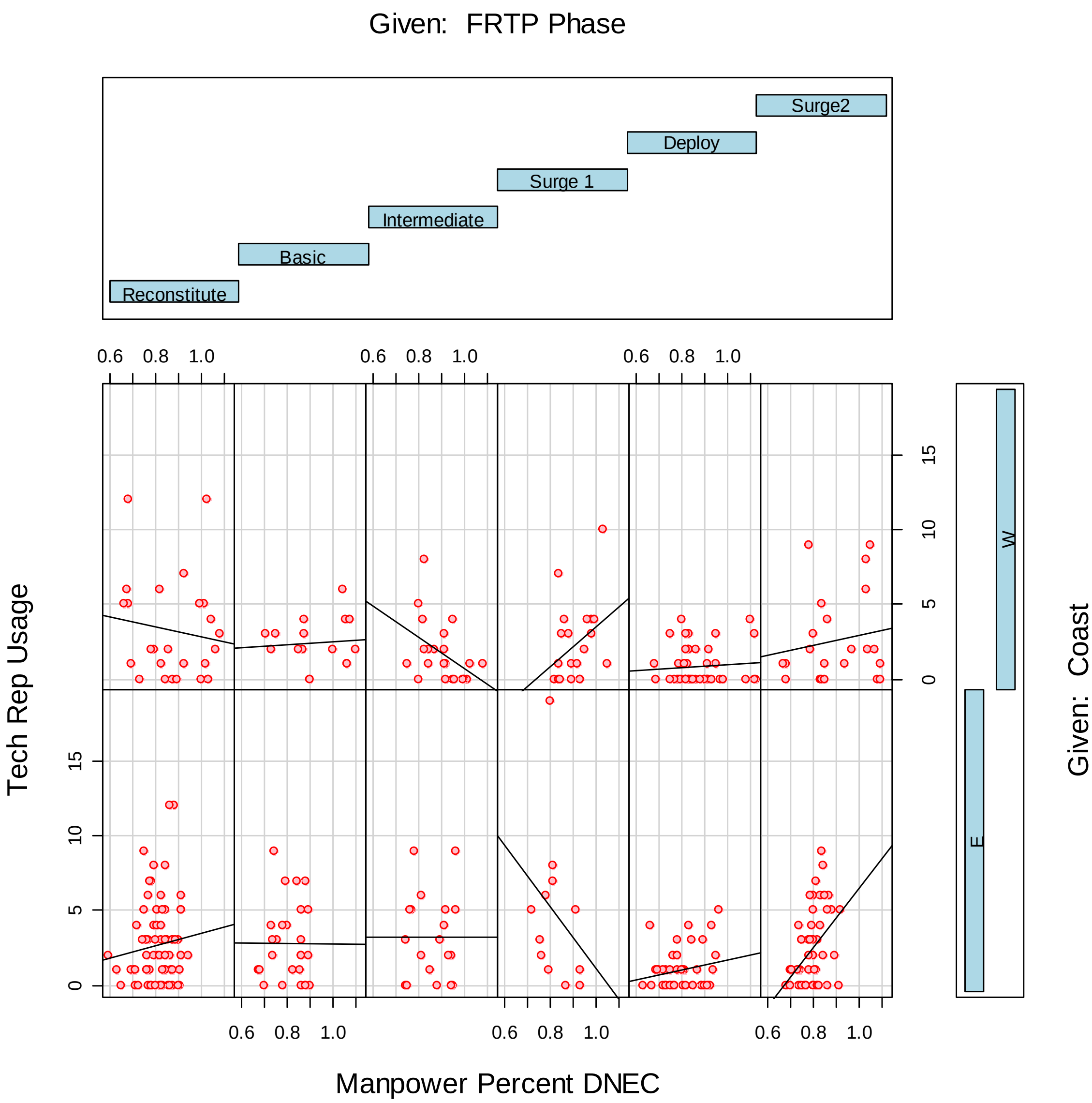

Figure 61. Manpower Percent DNEC compared to Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

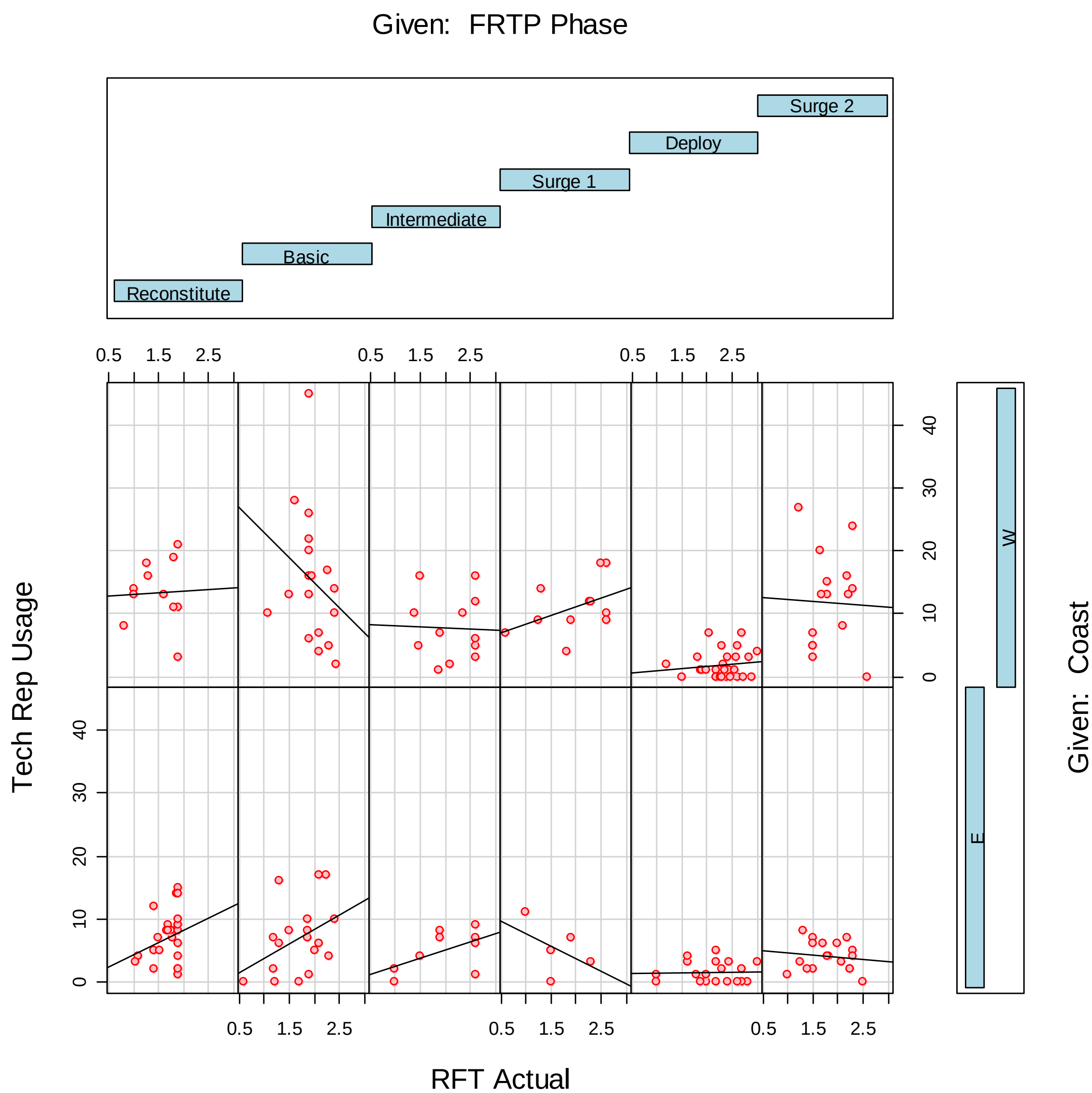

Figure 62. RFT Actual compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

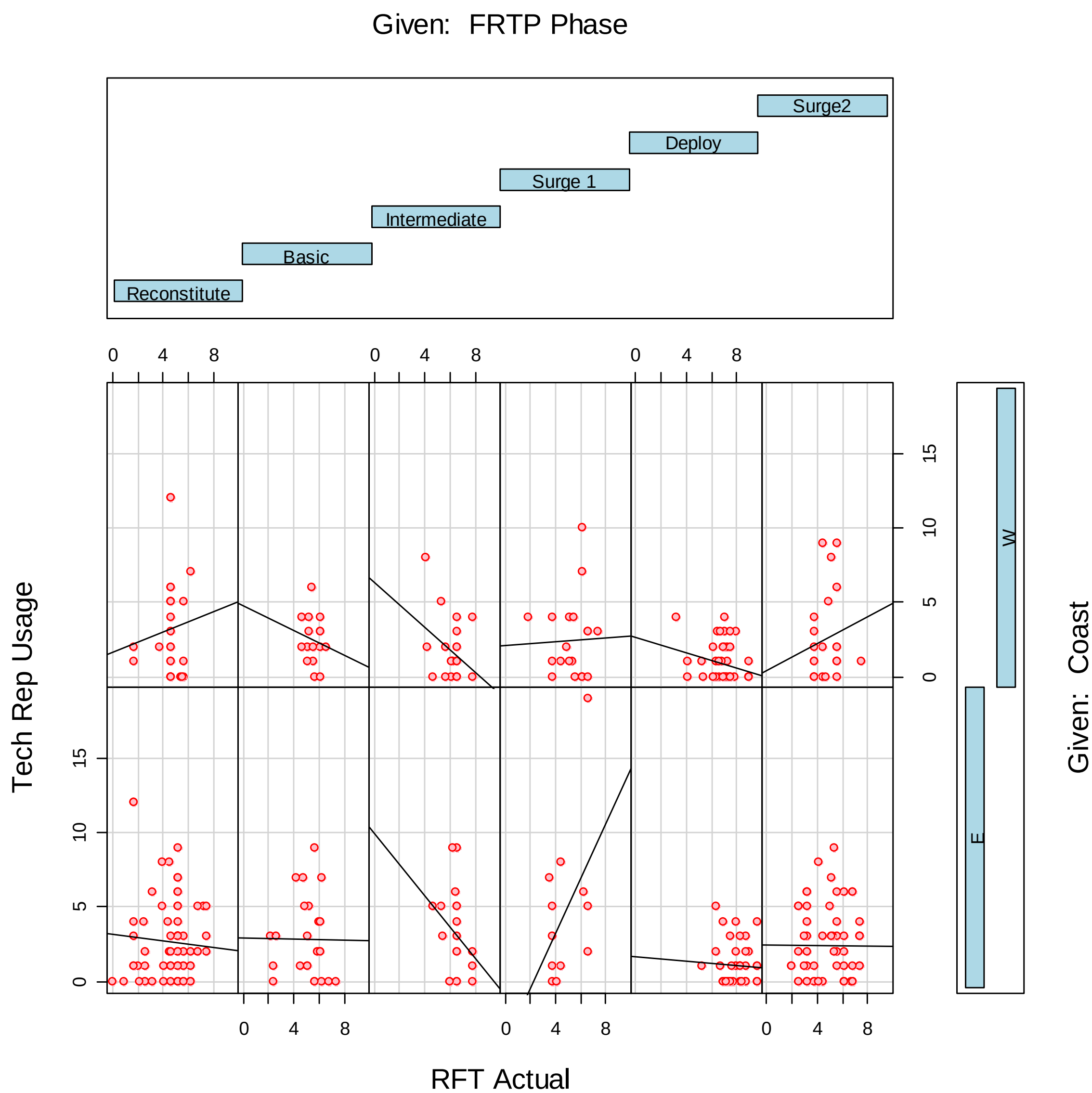

Figure 63. RFT Actual compared to Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

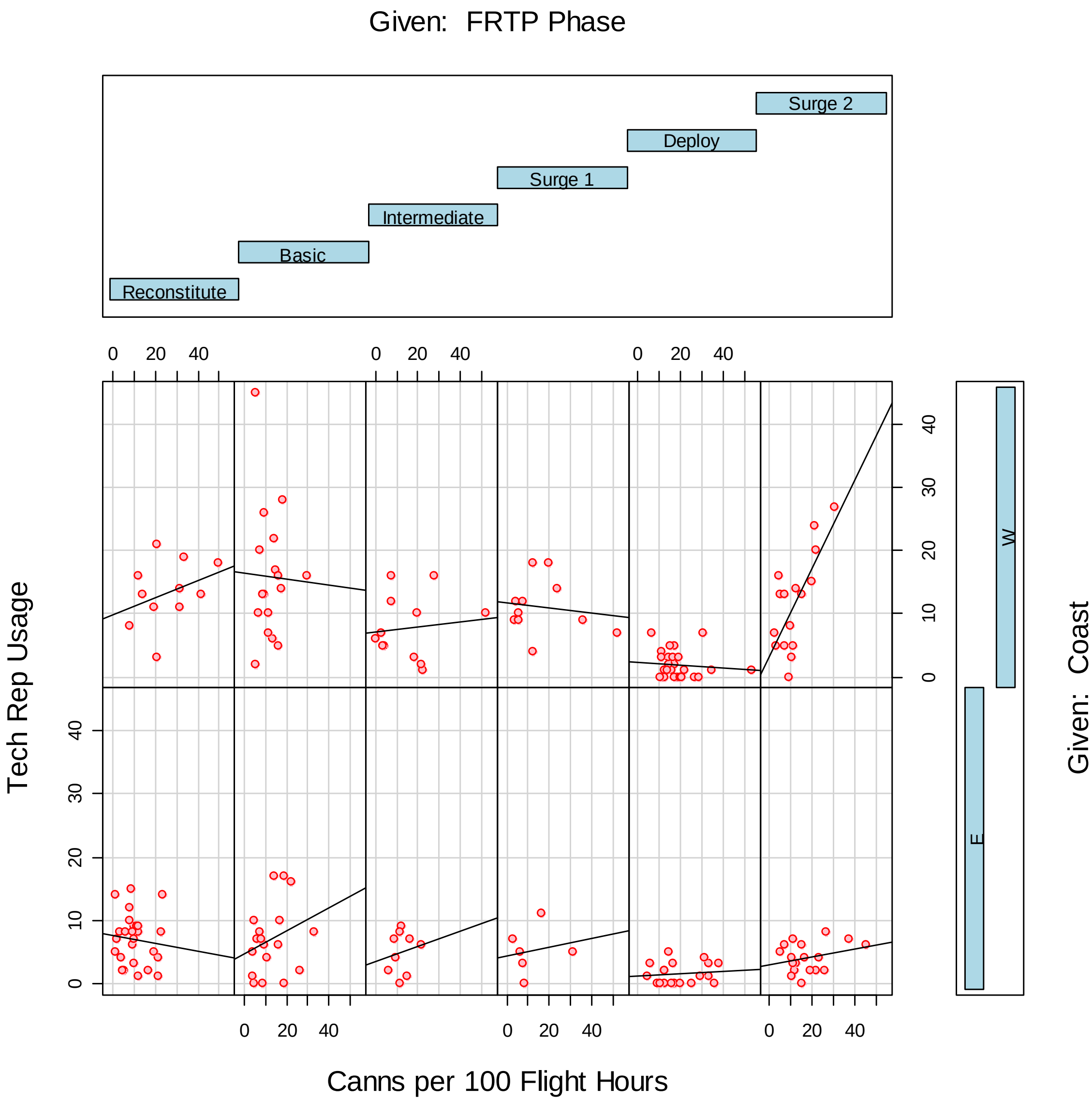

Figure 64. Cannibalizations per 100 Flight Hours compared to Tech Rep Usage per Month for E2-C Squadrons by Coast and FRTP Phase

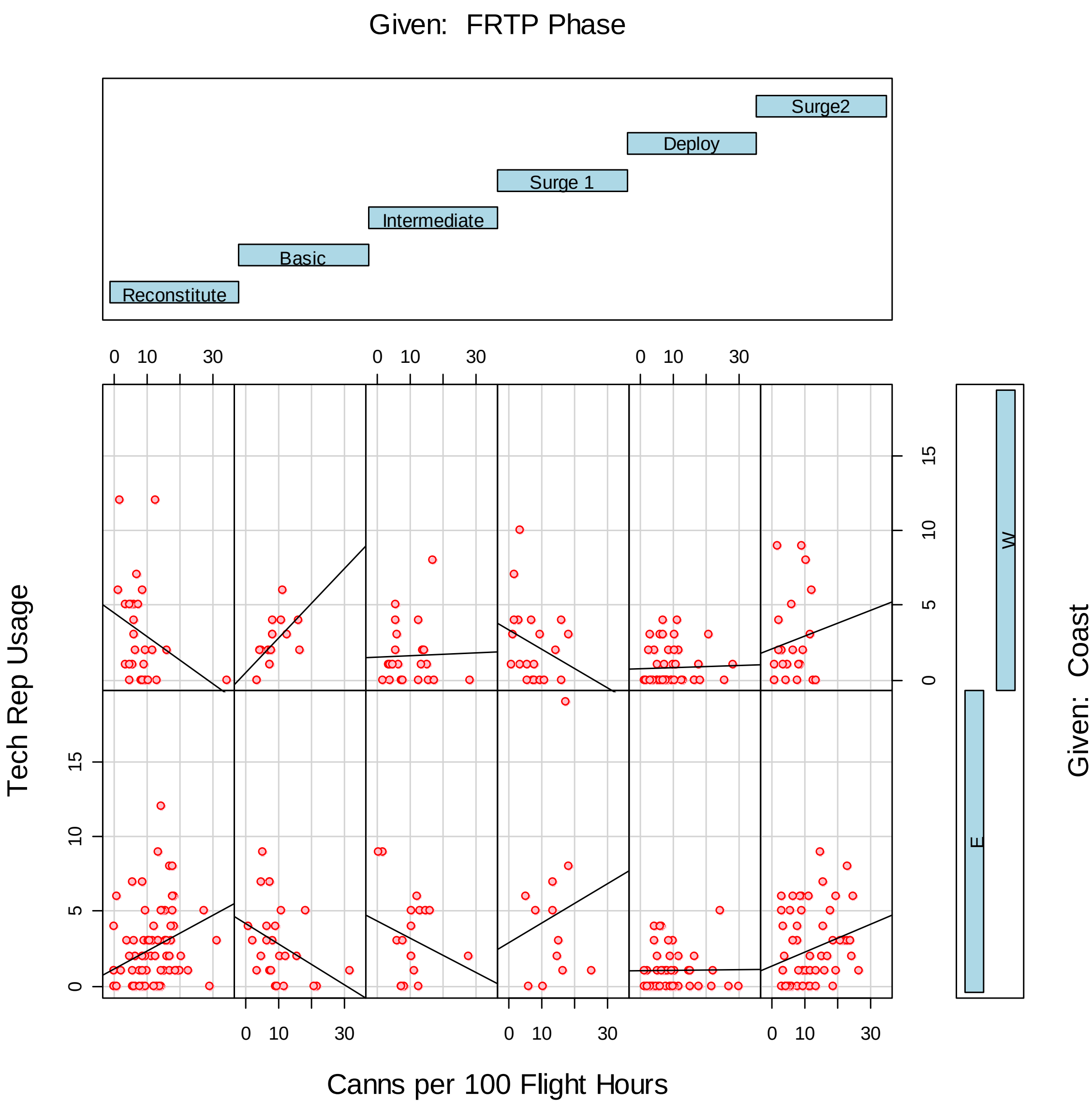

Figure 65. Cannibalizations per 100 Flight Hours compared to Tech Rep Usage per Month for FA-18C/D Squadrons by Coast and FRTP Phase

APPENDIX D. TRANSLATION OF MODEL VARIABLES

Model Variable	Defined Variable	Model Variable	Defined Variable
100FltHrs	100s of Flight Hours	FltHrNmc	Flight Hours per NMC Event
AcftInSvc	Aircraft In Service	FltHrs	Flight Hours
AcftInv	Aircraft Inventory	FltHrsEnt	Flight Hour Entitlement
AdBa	AD BA	FuelCost	Fuel Cost
AdCob	AD COB	HrsInMonth	Hours in Month
AdNmp	AD NMP	MaintBa	Combined Maintainers BA
AeBa	AE BA	MaintCob	Combined Maintainers COB
AeCob	AE COB	MaintHrFltHr	Maintenance Hours per Flight Hour
AeNmp	AE NMP	MaintHrs	Maintenance Hours
AfastFltHr	AFAST Flight Hours	MaintNmp	Combined Maintainers NMP
AFM	AFM Expenditures	MnPwrDNEC	Manpower Percent DNEC
AfmAimd	AIMD AFM (calculated by AimdAfmNotUse minus AfmOvhd)	Mo/Yr	Month/Year
AfmOther	Squadron AFM	NMCEvents	NMC Events
AfmOvhd	AFM Overhead	NMCHrs	NMC Hours
AimdAfmNotUse	Complete AIMD Expenditure (do not use)	NMCRate	NMC Rate
AmBa	AM BA	NmcsPmcs	NMCS/PMCS Requisitions
AmCob	AM COB	NonDepDct	Non Depot dCT
AmeBa	AME BA	NonDepWip	Non Depot WIP
AmeCob	AME COB	NonDepWIP	Non Depot WIP
AmeNmp	AME NMP	NonNmcsPmcs	Non-NMCS/PMCS Requisitions
AmNmp	AM NMP	Number	Number used for sorting squadrons
AoBa	AO BA	Pafm	Planned AFM Expenditure
AoCob	AO COB	Pavdlr	Planned AVDLR Expenditure
AoNmp	AO NMP	PctFirstDay	Percent of FirstDayIssue
AtBa	AT BA	Pfuel	Planned Fuel Expenditure
AtCob	AT COB	Phrs	Planned Flight Hours
AtNmp	AT NMP	Rcat	FRTP Phase (Categorical)
AVDLR	AVDLR Expenditures	RCatNo	FRTP Phase (Numeric)
Cann100FltHr	Canns per 100 Flight Hours	RftAct	RFT Actual
Cann100FltHrEnt	Canns per 100 Flight Hours Entitlement	RftEnt	RFT Entitlement
Canns	Cannibalizations (Canns)	RNumber	FRTP Month
Coast	Coast	SortieEnt	Sortie Entitlement
DaysInMonth	Days in Month	SQDN	Squadron
EISHrs	EIS Hours	Throughput	Throughput
ElarCount	Tech Rep Usage	TM	Type Model
ElarHrs	Tech Rep Hours	TMS	Type Model Series
FirstDayIssue	First Day Issue of NMCS/PMCS Requisitions		

Table 13. Translation of Model Variables to Defined Variables

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Table 14 includes Points of Contact for information and databases contained in this thesis as of March 2007.

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						Works for CNAF
Nichols	Gary	CIV	NATEC	ELAR (F-18)	619-545-2385	gary.m.nichols@navy.mil
Miller	Brian	CIV	NAVAIR	eRIIP/NAVRIIP	301-757-8902	brian.miller@navy.mil
						Excel Files that should match eRIIP
Murray	Tommy	CIV	EPMAC	EDVR	901-873-5240	tommy.murray@navy.mil
						901-873-5241

Table 14. Points of Contact

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LIST OF REFERENCES

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